Supplementary Material for

Renal osmoregulation depends on GRHL2-mediated collecting duct epithelial barrier function

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Supplemental Figures

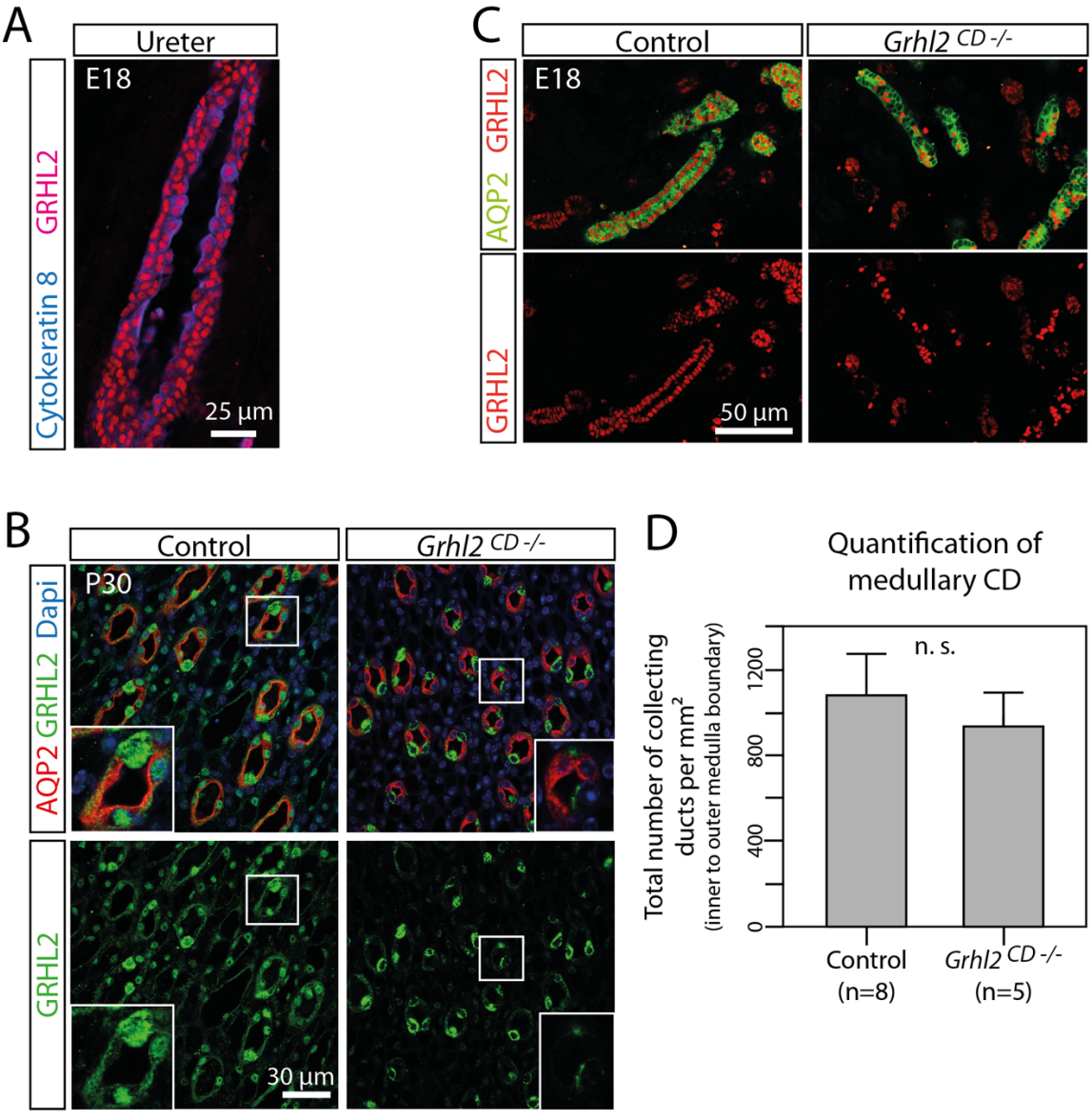


Fig. S1: (**A**) GRHL2 and cytokeratin 8 co-immunofluorescence staining on E18 kidney sections indicate high GRHL2 protein levels in the urothelium. Scale bar: 25 µm. (**B-C**) *Grhl2* $^{CD\ -/-}$ mice exhibit a knockout of *Grhl2* within the majority of collecting duct cells in P30 (B) and embryonic day 18 kidneys (**C**). Please note that the Grhl2 antibody produces a cytoplasmic immunofluorescent signal in intercalated cells that likely reflects the truncated form of Grhl2 produced from exons 1-4 of the mutant allele, which we previously described.[1] (**D**) Quantification of the number of collecting ducts per 35,100 µm² of inner medulla at the border to the outer medulla reveals no significant differences comparing control and *Grhl2* $^{CD\ -/-}$ mice. (**E**) Masson trichrome stained paraffin kidney sections at the level of the border between inner and outer medulla of P30 littermates reveal no evidence of renal fibrosis in *Grhl2* $^{CD\ -/-}$ mice. Scale bar: 100 µm.

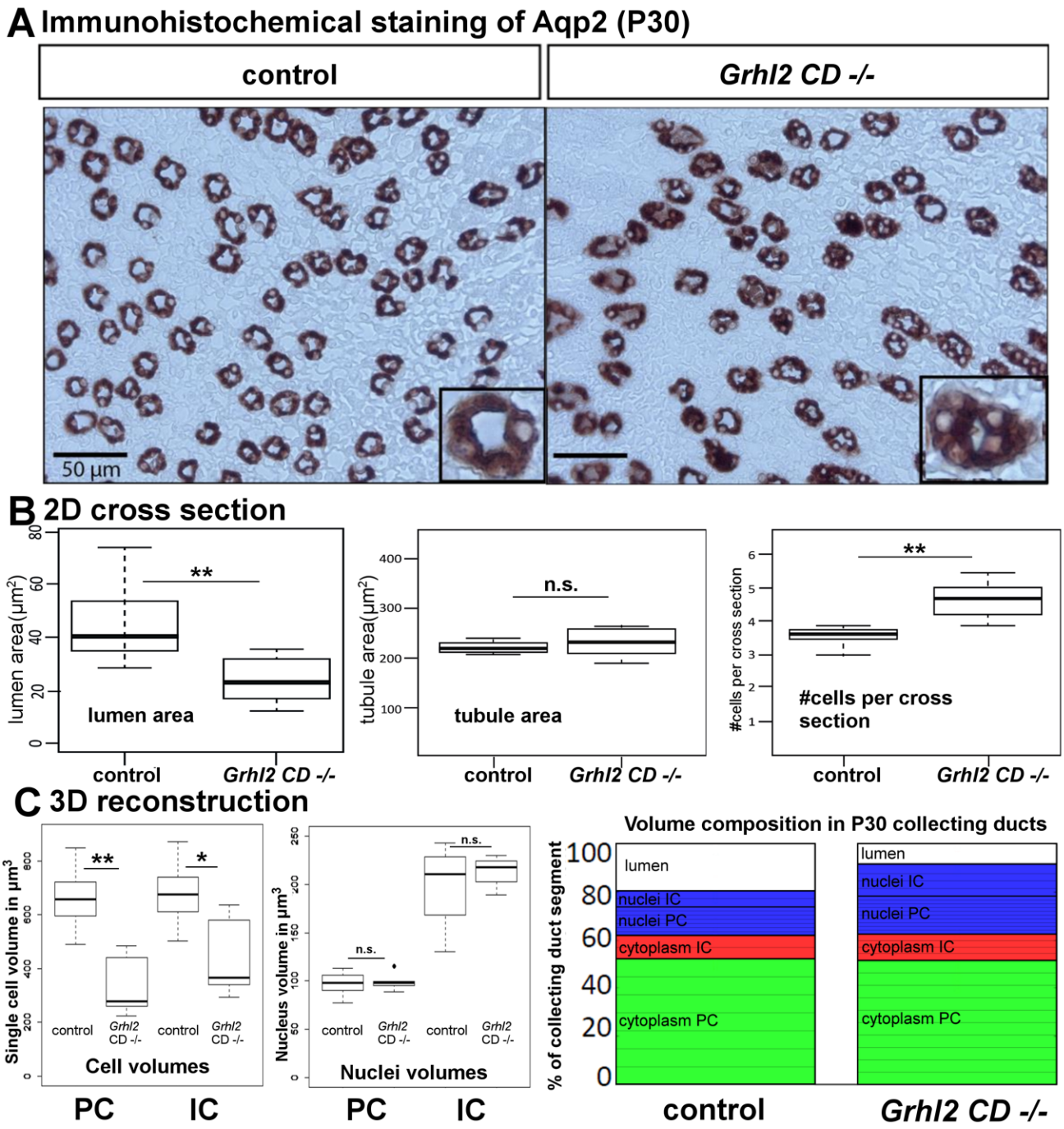


Fig. S2: Morphology of collecting duct epithelia in *Grhl2* $^{CD\ -/-}$ mice. (**A**) Aquaporin 2 (AQP2) immunohistochemical staining on postnatal day 30 kidney sections representing the border between inner and outer medulla in control and *Grhl2* $^{CD\ -/-}$ kidneys. Scale bar: 50 µm. (**B**) Analysis of collecting duct lumen areas (40.24 µm^2 in controls vs. 23.4 µm^2 in *Grhl2* $^{CD\ -/-}$ mice; n=10), areas covered by collecting duct tubules (including cells and lumen) (n=10), and numbers of cells per collecting duct cross section (3.6 cells per cross section in

controls vs. 4.6 cell per cross section in *Grhl2* $^{CD\ -/-}$ mice; n=6) at the border between outer and inner medulla. (**C**) 3D reconstruction of collecting ducts. Single cell volume analyses (left) and nuclear volume analysis (middle) of principal cells (PCs) and intercalated cells (ICs) in *Grhl2* $^{CD\ -/-}$ and control collecting ducts of postnatal day 30 mice (n=5). The collecting duct cell size is significantly decreased in *Grhl2*-deficient kidneys compared to controls with a reduction of 49% for PCs (mean control = 663 µm^3 vs. mean *Grhl2* $^{CD\ -/-}$ = 337 µm^3) and 35% for ICs (mean control = 680 µm^3 vs. mean *Grhl2* $^{CD\ -/-}$ = 443 µm^3). Nuclei volumes of PCs and ICs are similar in *Grhl2* $^{CD\ -/-}$ and control kidneys. The right panel shows the contribution of each indicated component of the collecting duct (in %) to the total volume of the collecting duct (100%) for one representative *Grhl2* $^{CD\ -/-}$ and control collecting duct. Thinner horizontal lines represent the contribution of individual cells. Note that total collecting duct volumes are similar between *Grhl2* $^{CD\ -/-}$ and control mice. *, $P<0.05$; **, $P<0.01$; n.s., non-significant.

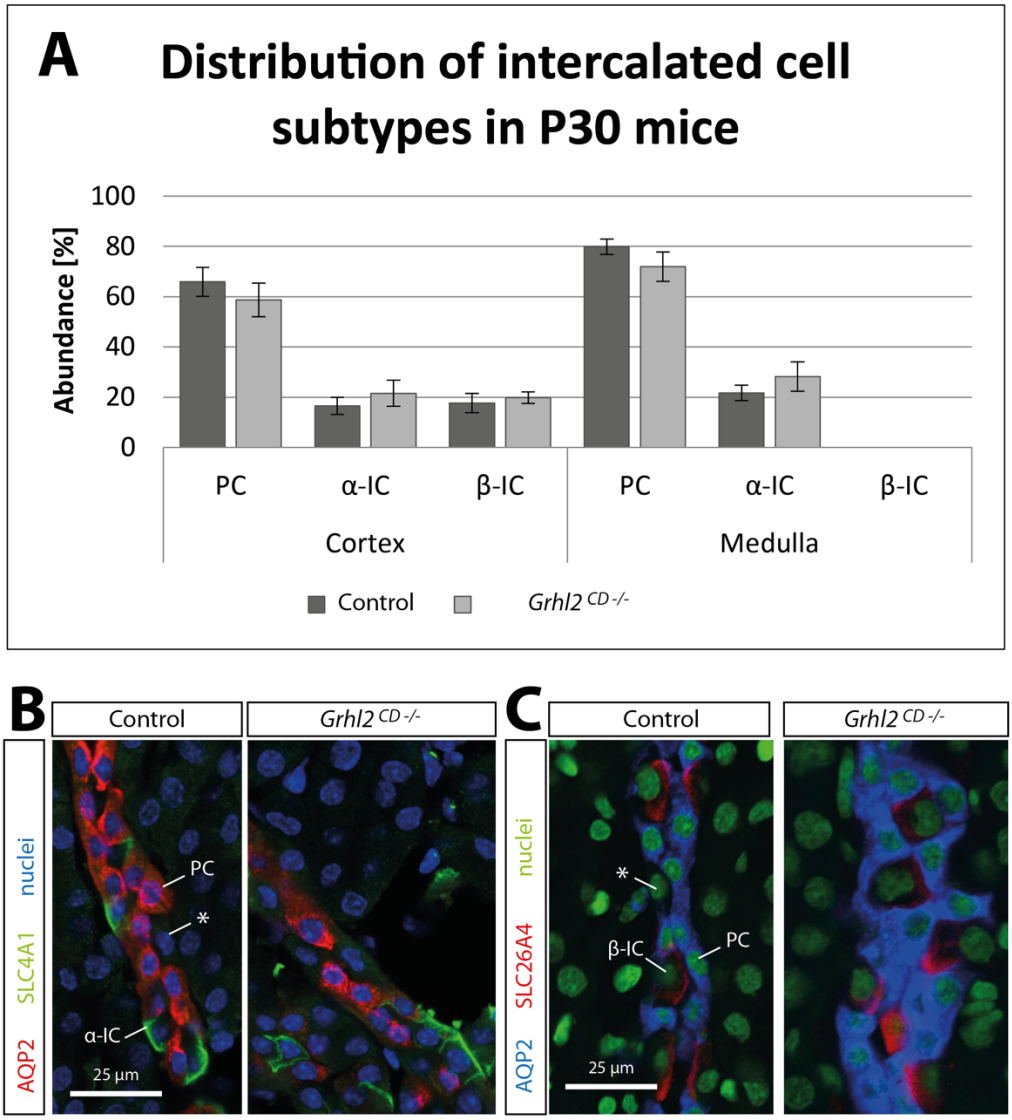


Fig. S3: No deviation in the relative abundance of principal and intercalated cells in kidneys of *Grhl2* $^{CD\ -/-}$ mice. (**A**) Distribution of principal (PC) and intercalated cell (IC) subtypes in P30 kidneys of *Grhl2* $^{CD\ -/-}$ mice and controls. Cell abundances were determined by immunofluorescence stainings using antibodies against Aquaporin 2 (AQP2), anion exchanger member 1 (SLC4A1) and Pendrin (SLC26A4) (see B-C for exemplary stainings). We counted cells in their respective class (PC, IC α or β-subtype) according to immunofluorescently detected characteristic transporter proteins AQP2, SLC4A1 or SLC26A4, respectively. In figures **B-C** an exemplary PC, α-IC, and β-IC are labeled. Asterisks designate non-labeled collecting duct cells likely representing β-ICs in B and α-ICs in C. Scale bar: 25 µm.

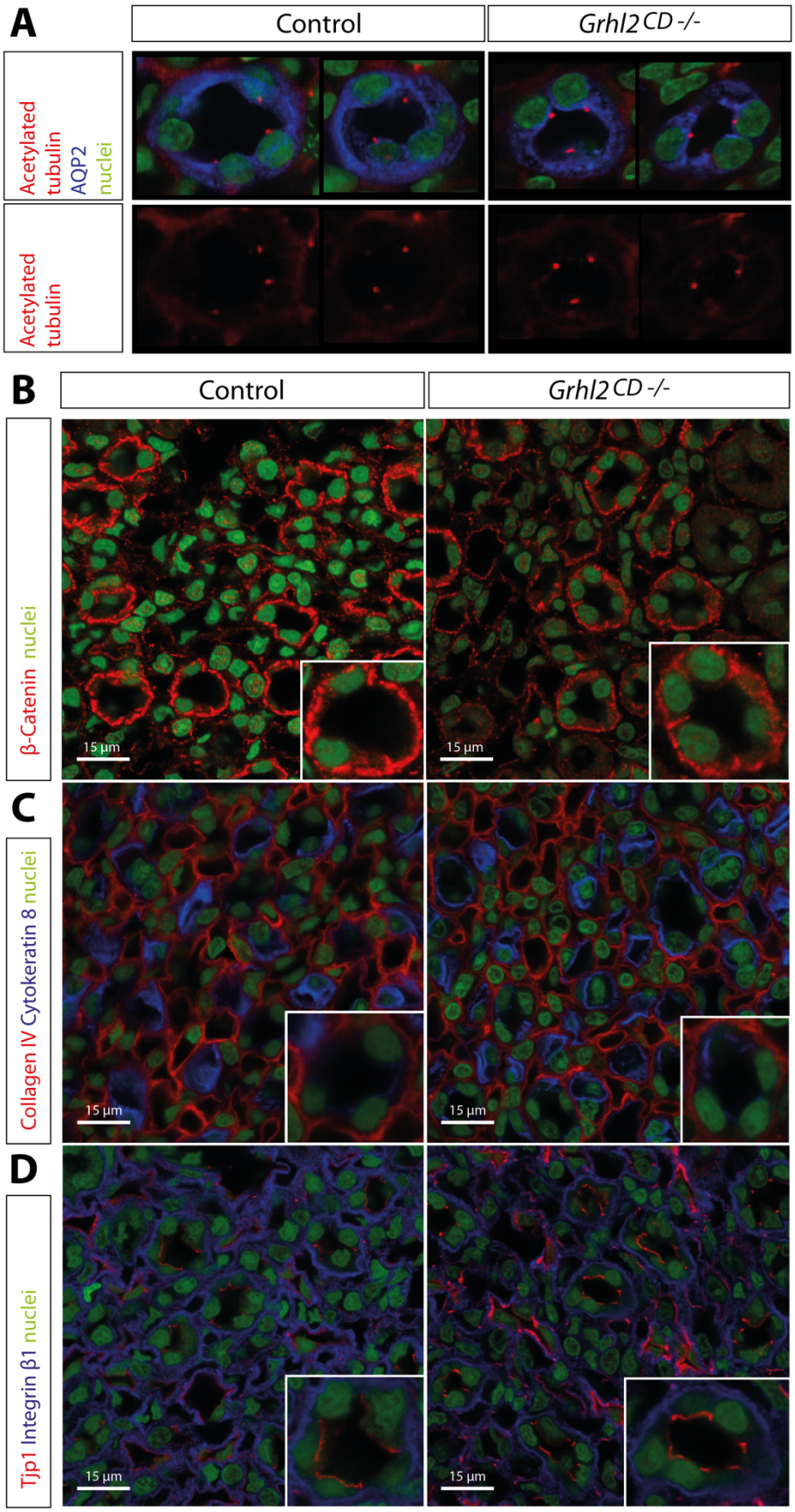

A
Control
Grhl2 CD -/-
Acetylated tubulin AQP2 nuclei
Acetylated tubulin
B
Control
Grhl2 CD -/-
β-Catenin nuclei
15 µm
15 µm
C
Collagen IV Cytokeratin 8 nuclei
15 µm
15 µm
D
Tjp1 Integrin β1 nuclei
15 µm
15 µm

Fig. S4: *Grhl2* $^{CD\ -/-}$ mice display normal primary cilia and epithelial cell polarity in the collecting duct. (**A**) Immunofluorescent staining of acetylated tubulin on P30 kidney sections shows primary cilia in the same frequency as found in control littermates. (**B-D**) Cell polarity is not disturbed in inner medullary collecting duct cells of *Grhl2* $^{CD\ -/-}$. The detection of basal (β-catenin, collagen IV, integrin β1) and apical (cytokeratin 8, TJP1) cell membrane markers on P30 mutant versus control kidneys by immunofluorescent staining reveals intact basolateral and apical cell domains in *Grhl2* $^{CD\ -/-}$ mice. Scale bar: 15 µm.

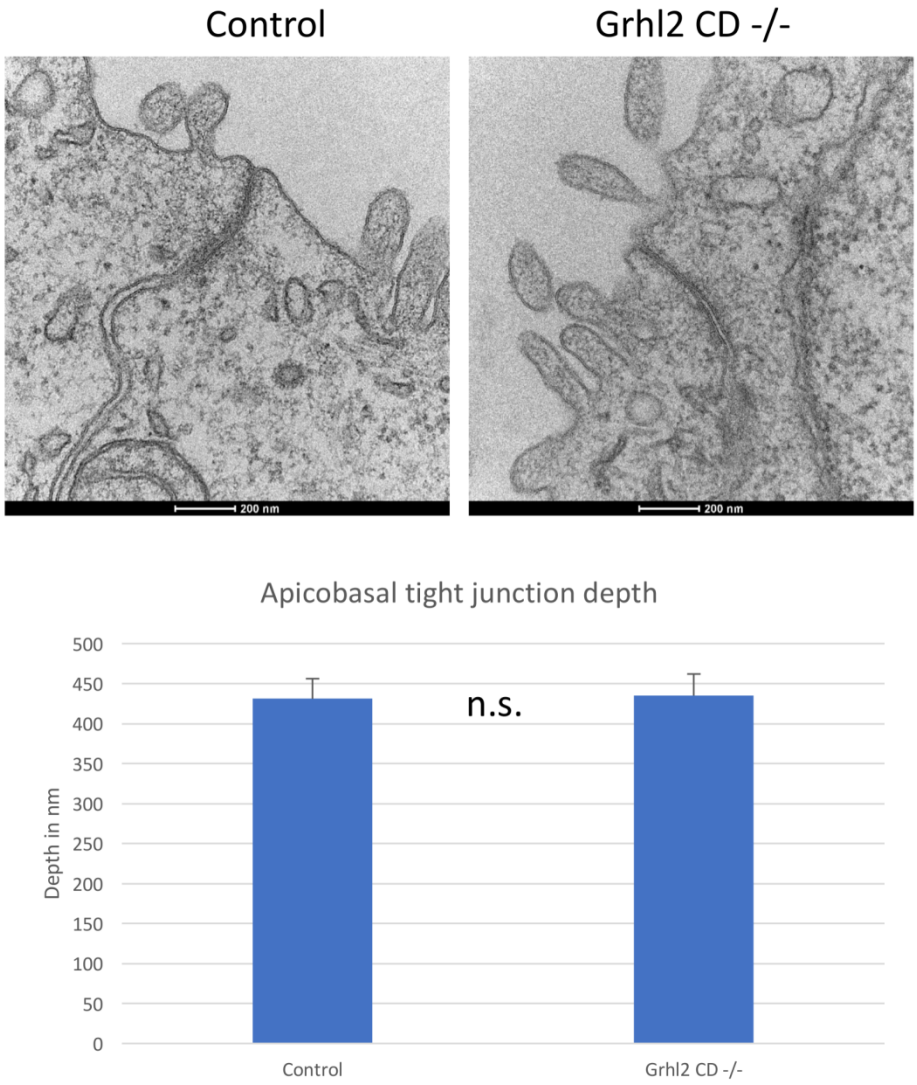


Fig. S5: Tight junction architecture in *Grhl2*-deficient collecting ducts. Electron microscopic analysis of collecting duct morphology in control and *Grhl2* $^{CD\ -/-}$ mice, indicating that tight junctions are present and ultrastructurally normal. Upper panel shows a high resolution image of representative tight junctions for both groups. The lower plot compares apicobasal tight junction depth between control and *Grhl2* $^{CD\ -/-}$ (n= 3 *Grhl2* $^{CD\ -/-}$ vs. 2 control mice, in each animal at least 10 perpendicularly sectioned tight junctions were analyzed).

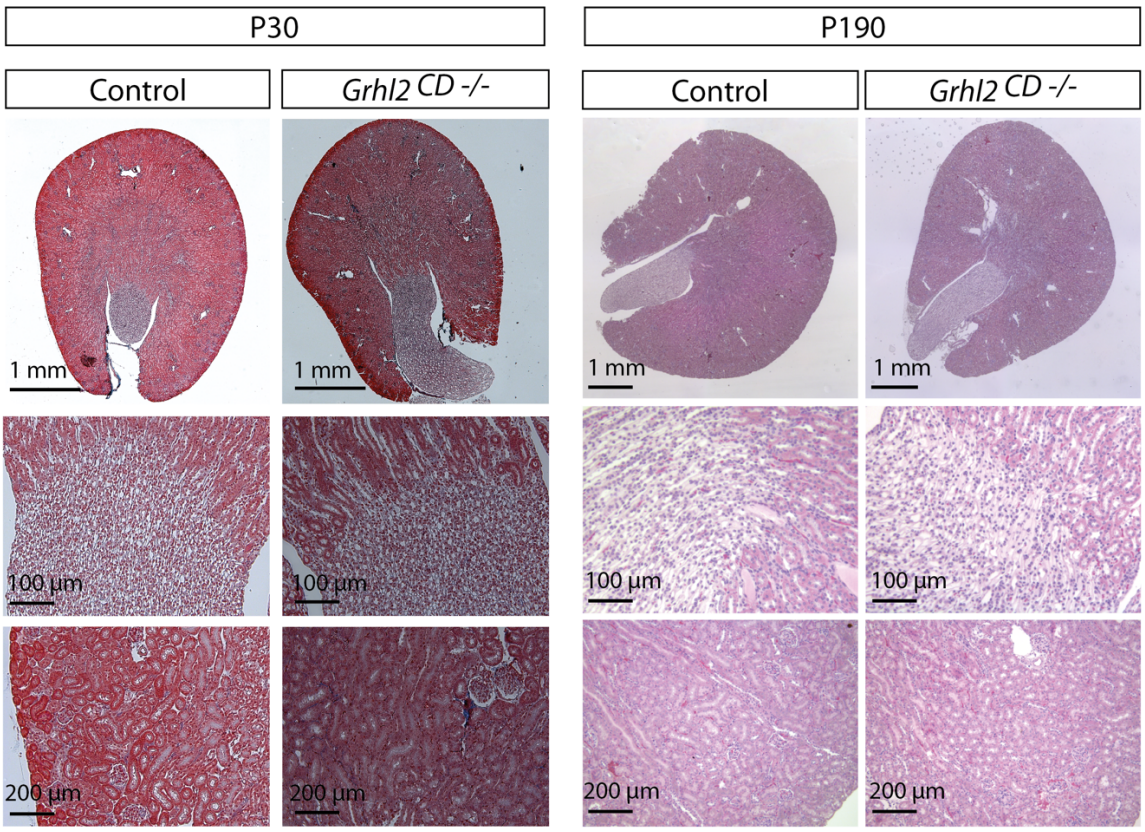


Fig. S6: H&E-stained kidney sections of 1 and 6 months old mice. Histological analysis reveal no differences between kidneys of P30 and adult *Grhl2* $^{CD\ -/-}$ mice.

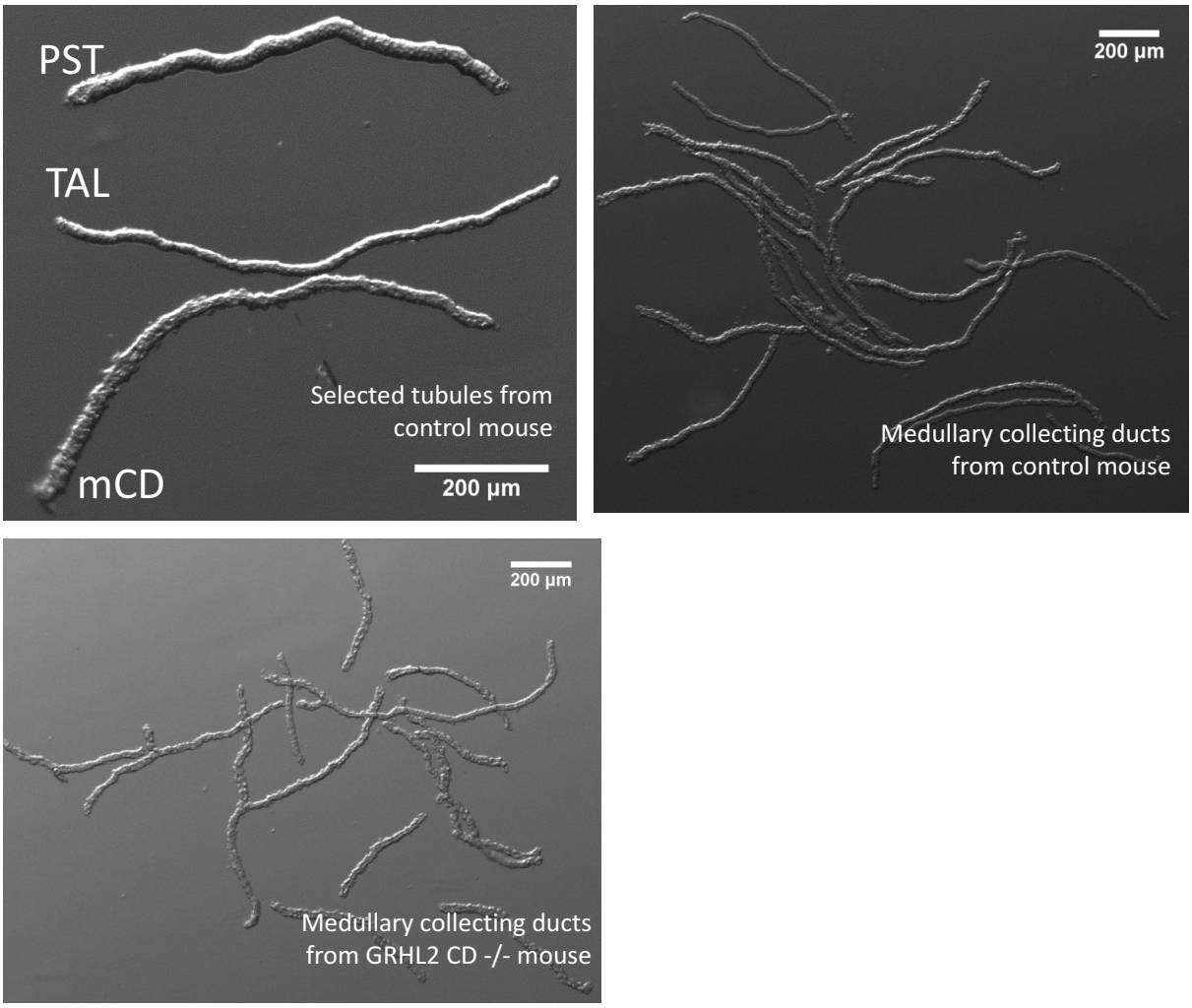


Fig. S7: Images captured during microdissection of control and Grhl2 CD -/- kidneys for GRHL2 tight junction target validation. As indicated in the panels, medullary collecting ducts were selected for RNA extraction and target gene validation as depicted in Fig. 3.

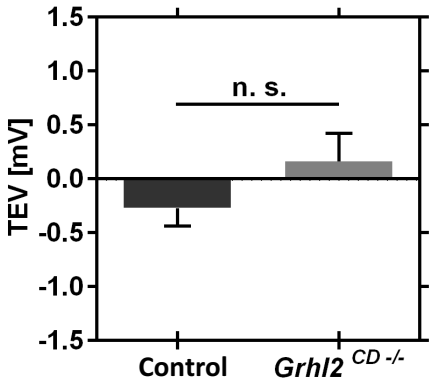


Fig. S8: Transepithelial voltage measurements of isolated collecting ducts show no significant difference between control and *Grhl2* $^{CD\ -/-}$ mice (-0.27 vs. 0.16 mV; mean ± SEM; n. s., non-significant).

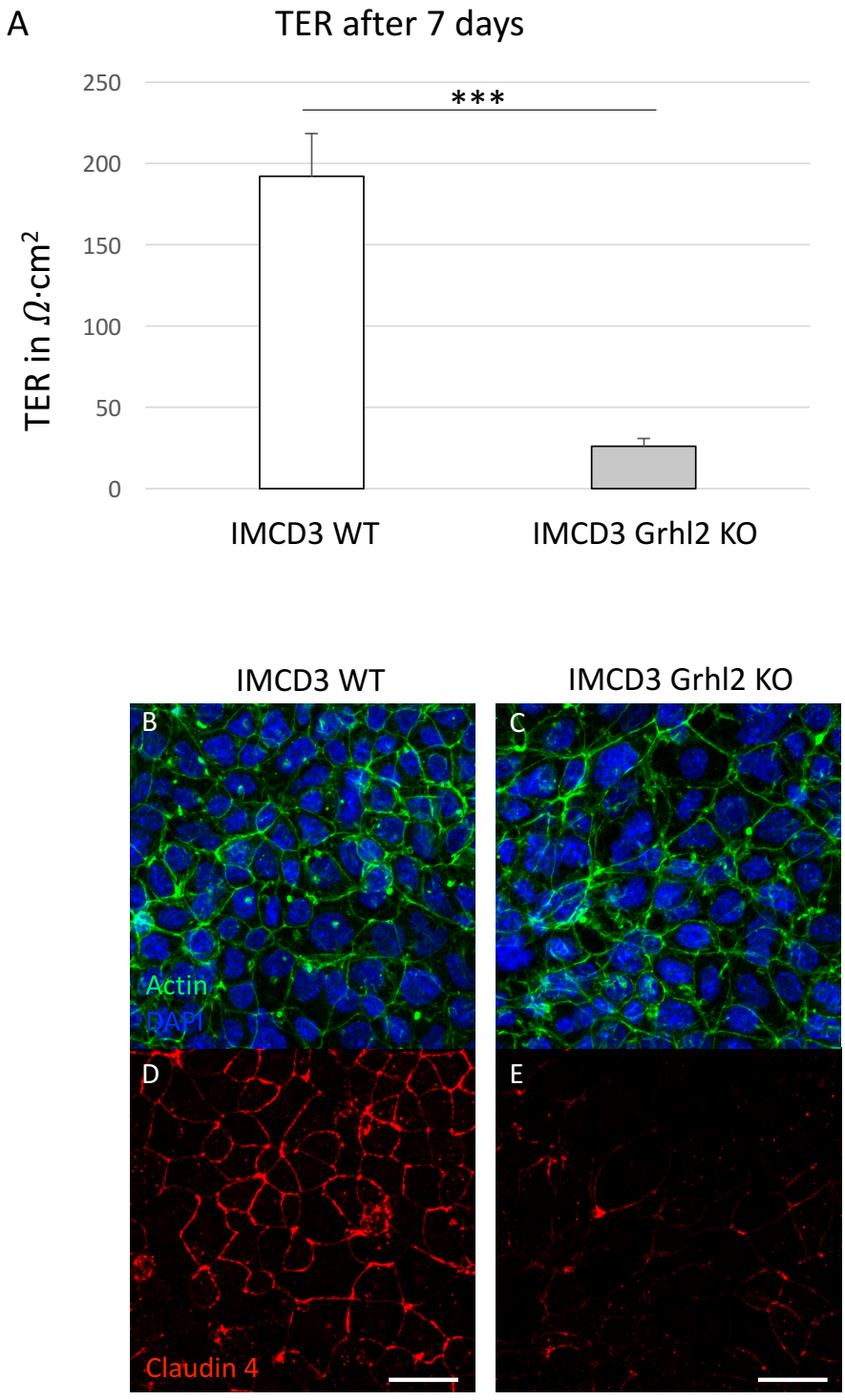


Fig. S9: Transepithelial resistance (TER) and cell layer morphology of control and Grhl2 knockout IMCD3 cells (Grhl2-KO-IMCD3 cells). (A) TER across confluent cell layers was markedly decreased in Grhl2-KO-IMCD3 cells compared to wildtype (WT) IMCD3 cells (mean + SD, *** P<0.001, Student's t-test, n=5). (**B-E)** Fluorescent labeling of F-actin (green), claudin 4 (red) and nuclei (blue) of confluent monolayers (Scale bar: 15μm).

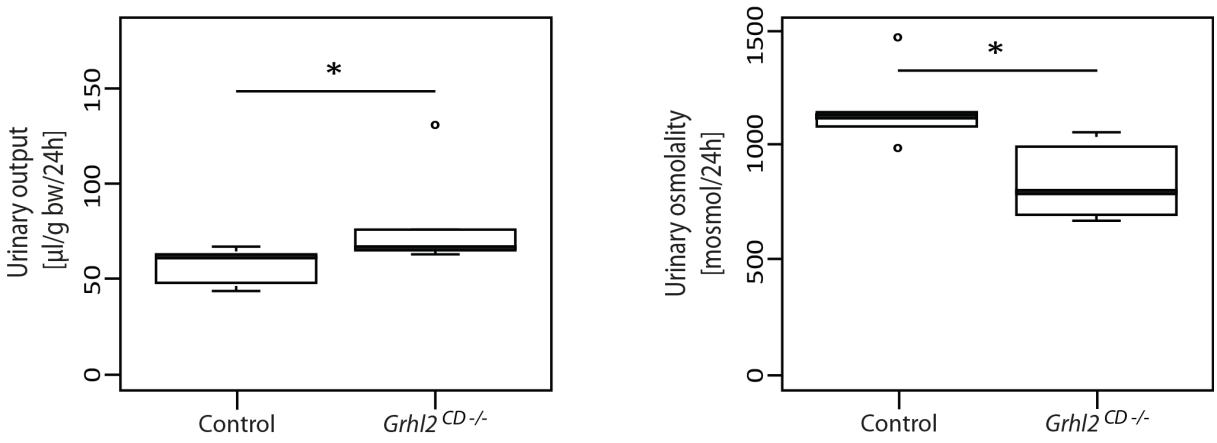


Fig. S10: 24h urinary output and osmolality of 5-6 months old *Grhl2* $^{CD\ -/-}$ mice (n=5) and respective control litter mates (n=5) (* $p<0.05$, MWU-Test).

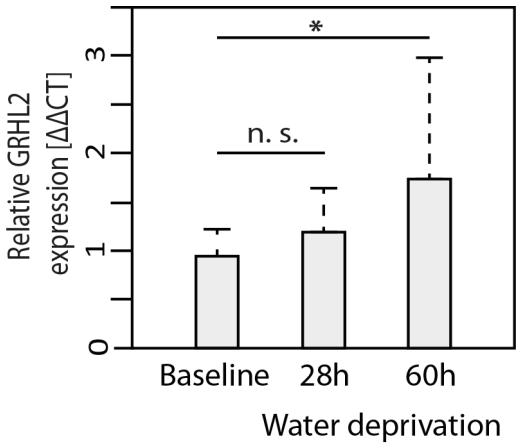


Fig. S11: mRNA expression analysis in wildtype mouse kidneys reveals a 1.87-fold increased renal *Grhl2* mRNA expression after 60 h of water deprivation (mean ± SD; *, $P<0.05$ (Student‘s t-test)).

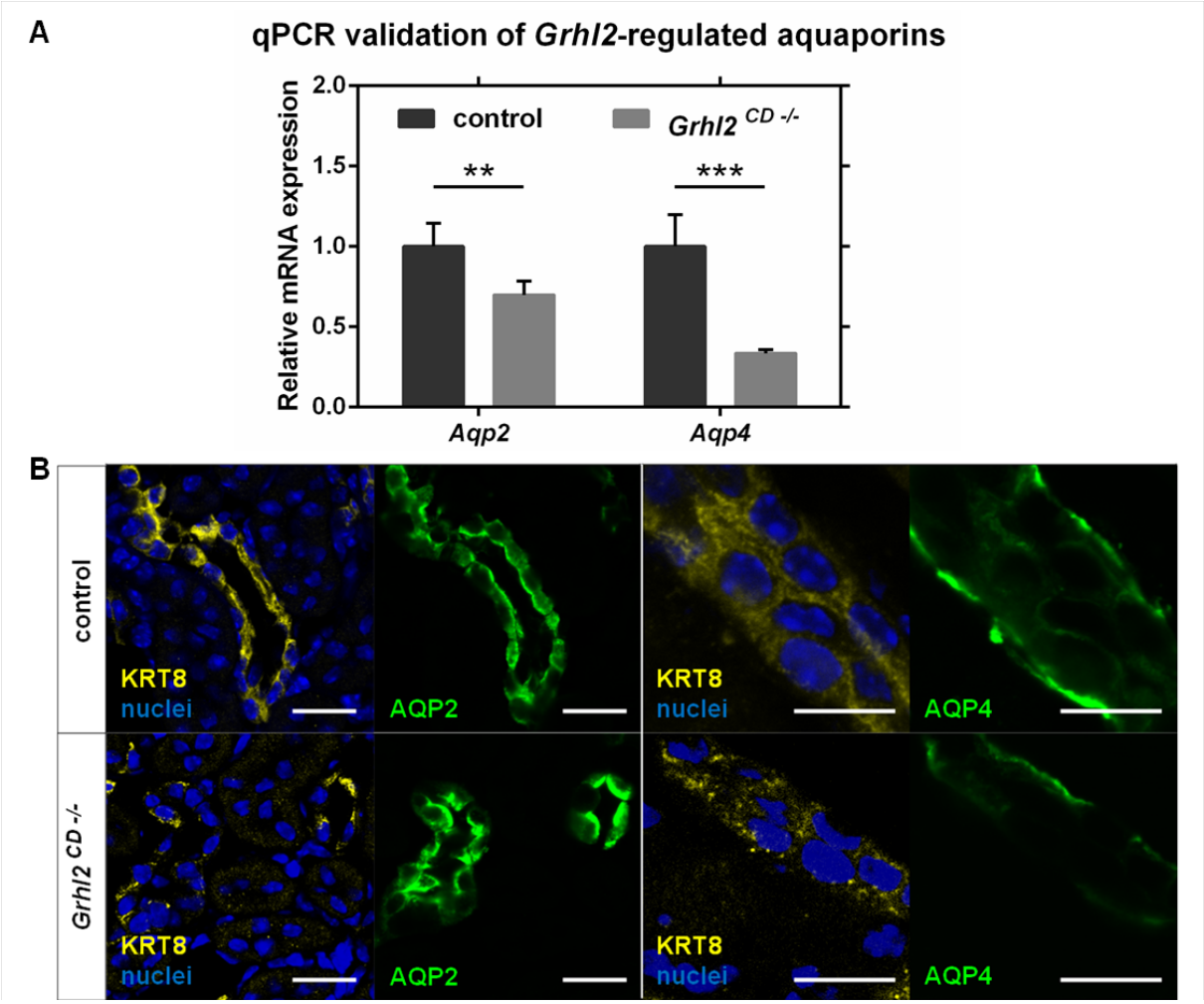


Fig. S12: Collecting ducts of *Grhl2* $^{CD\ -/-}$ mice display decreased levels of *Aqp2* and *Aqp4* mRNAs, but these alterations do not translate into alterations of apical and basolateral water transport. (**A**) qPCR validation of differential *Aqp2* and *Aqp4* expression as determined by microarray analysis (mean ± SD; n=4 biological replicates; **, *P*<0.01; ***, *P*<0.001 vs. controls, Student's t-test). (**B**) Immunofluorescence staining of 24h-thirsted kidneys of *Grhl2* $^{CD\ -/-}$ and control mice for cytokeratin 8 (KRT8), aquaporins 2 (AQP2) or 4 (AQP4) and nuclei (DAPI). Scale bars: AQP2: 20 µm, AQP4: 10 µm.

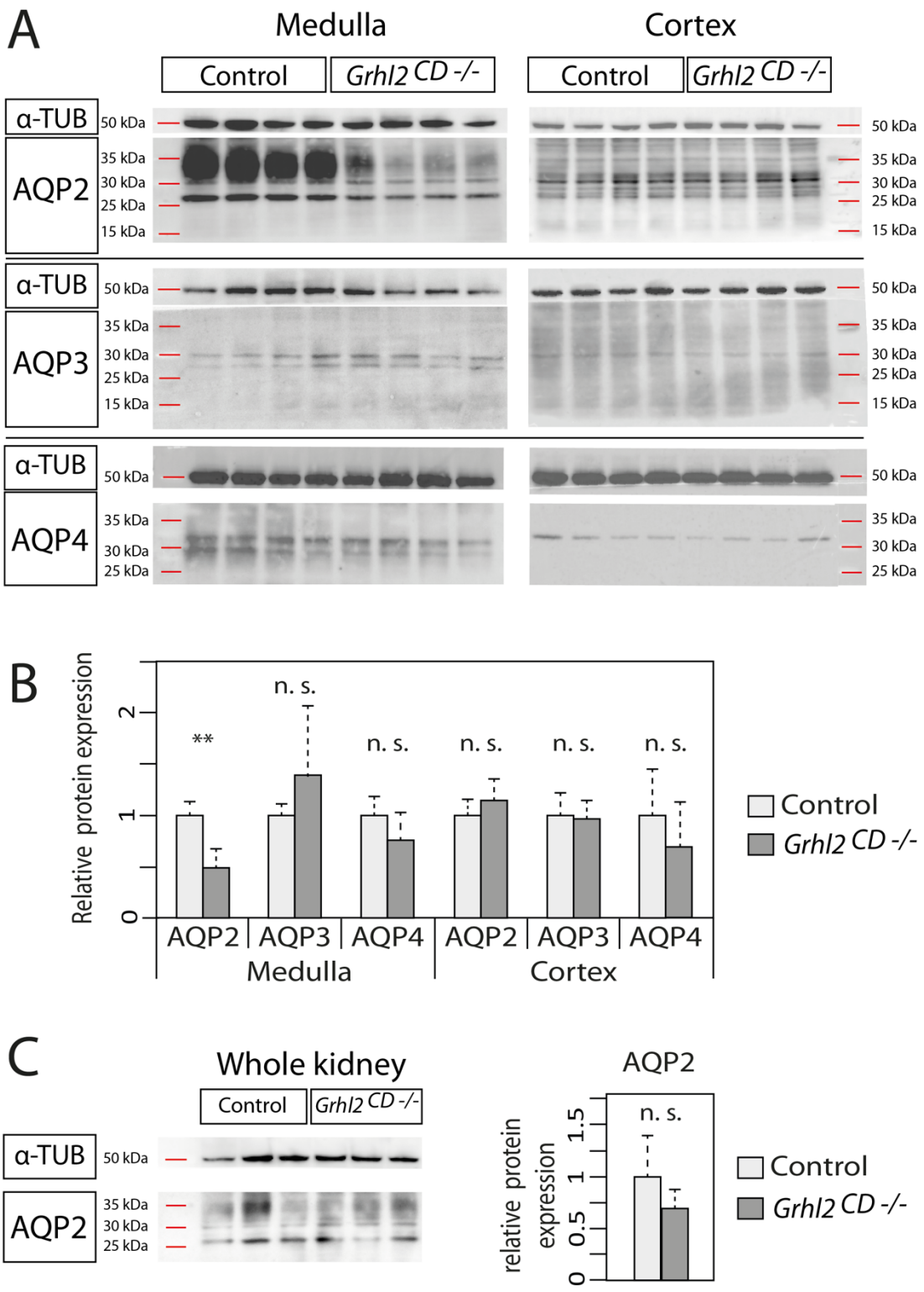


Fig. S13: Western blot analysis of aquaporin 2,3 and 4 expression in cortex, medulla and whole kidney.

(A) Western blot analysis of aquaporin 2,3 and 4 expression in cortex and medulla revealed no differential regulation of the respective AQP except for medullary AQP2. Quantification of Western Blot signal intensity was depicted in **B**. (**C**) Analysis of AQP2 expression in whole kidney lysates showed similar expression levels in *Grhl2* $^{CD\ -/-}$ mice and control litter mates.

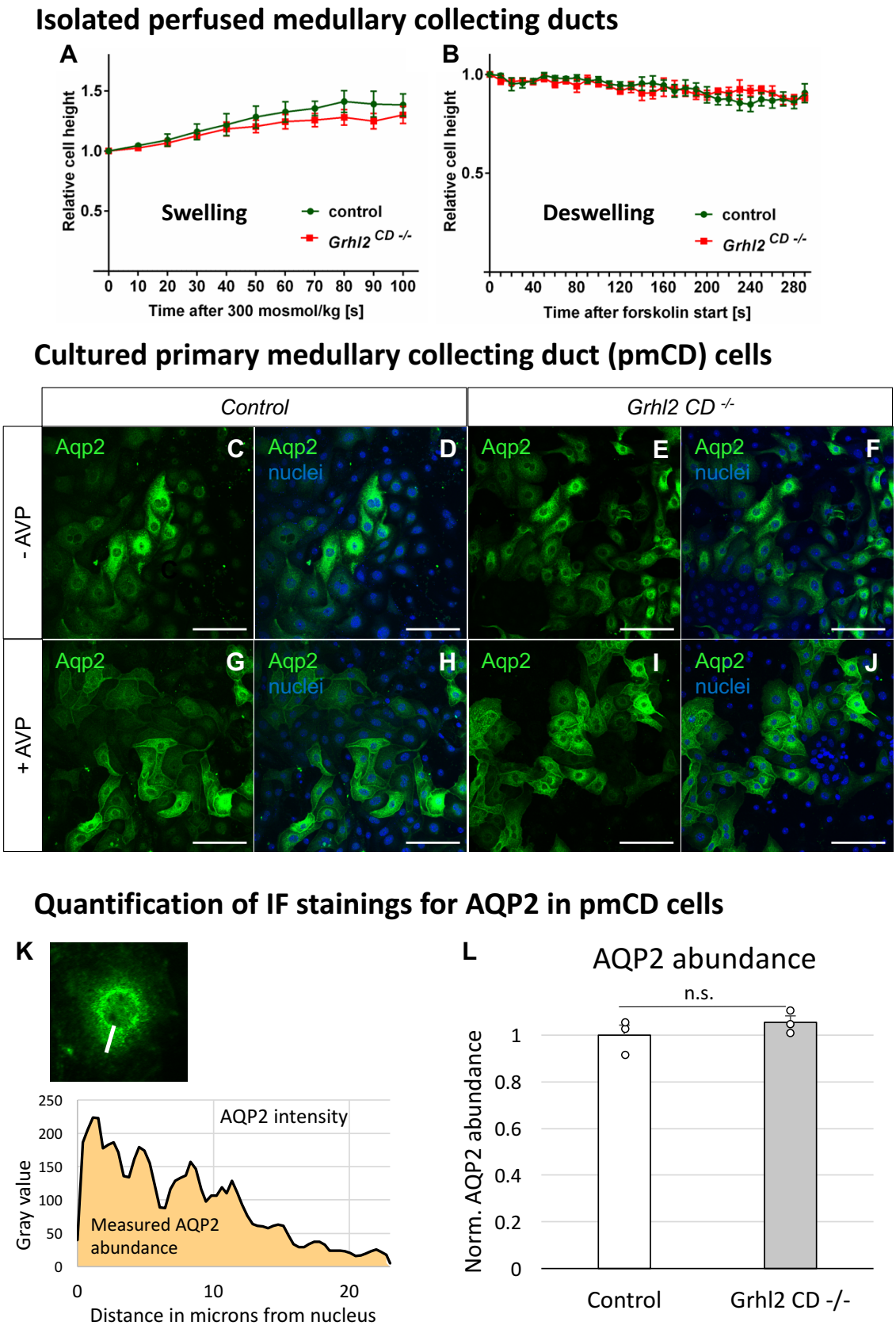


Fig. S14: Water transport in isolated CDs and AQP2 expression in isolated primary medullary CD (pmCD) cells. (A), (B): Tubular perfusion of isolated collecting ducts of the inner stripe of the outer medulla. CDs were incubated in 600 mosmol/kg solution to mimic the

natural osmotic conditions of the renal outer medulla. (**A**) Shifting the basolateral solution to 300 mosmol/kg induces cell swelling, representing water transport via basolateral aquaporins, such as AQP3 or AQP4. Morphometric analyses of relative cell height indicated similar dynamics of cell swelling in collecting ducts from *Grhl2* $^{CD\ -/-}$ mice compared to control mice. **(B)** Subsequently, 1 µM forskolin was added to the basolateral solution to induce cAMP signaling and apical translocation of AQP2. The temporal rate of deswelling in collecting ducts of *Grhl2* $^{CD\ -/-}$ mice and controls was similar, indicating adequate responsiveness of apical water transport to elevated cAMP levels. **(C-L)** Primary medullary collecting duct (pmCD) cells were isolated and kept in culture for 3 days in a 600mosm/kg medium[2]. pmCD cells were then left under control conditions (-AVP) (C-F) or stimulated with 100 nm AVP (G-J) for 30 min at 37°C. Stimulated and non-stimulated pmCD cells from control *Grhl2*$^{+/+}$ mice (C,D,G,H) and *Hoxb7;Grhl2*$^{flox/-}$ mice (E,F,I,J) were then analyzed by immunofluorescence staining (IF). AQP2 was detected with an antibody from Santa Cruz (C-17, sc-9882). Nuclei were visualized via TO-PRO-3 iodide. Scale bars: 500 nm. IF shows comparable abundances of AQP2 and apical shuttling in the two groups. **(K, L)** Quantification of fluorescence intensity of AQP2 in pmCD cells. (**K**) Example of AQP2 abundance in a single pmCD cell as quantified in the maximal intensity section from the level of the nucleus to the cell periphery (in µm)[3-5]. **(L)** Statistical analysis of 3 independent experiments each comprising pmCD cells from 15 control and 15 Grhl2 CD $^{-/-}$ mice (45 vs. 45 mice in total) does not show differences in mean AQP2 abundance under isosmotic conditions. AQP2 abundances are expressed as relative values with control CD AQP2 fluorescence set as 1 (mean ± SEM, P=0.34, Student's t-test). Averages from the 3 experiments are plotted as single dots.

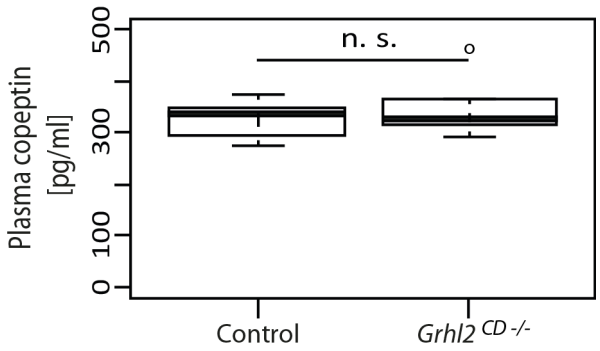
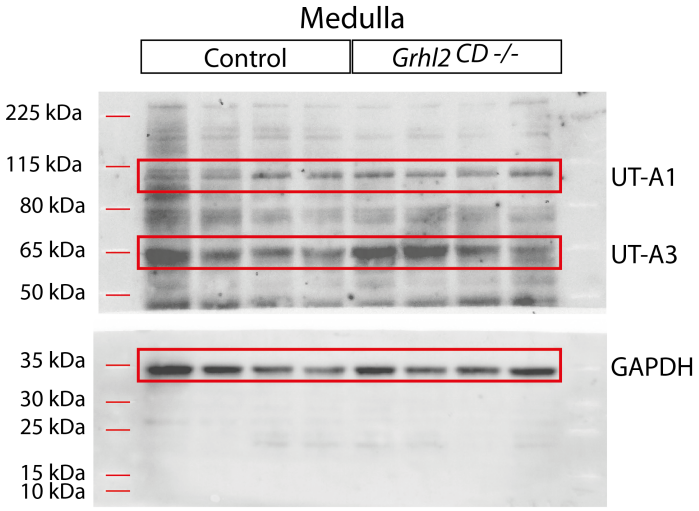
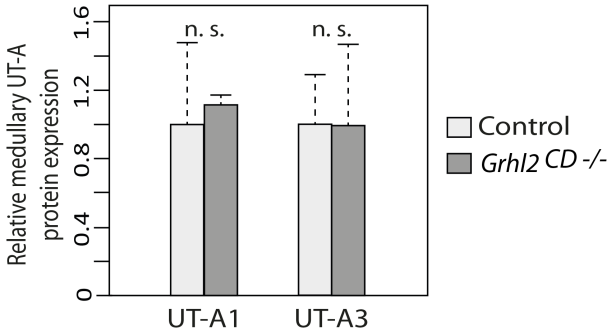


Fig. S15: Plasma copeptin analysis in 24h thirsted mice (n=5).


Medulla
Control
Grhl2 CD -/-
225 kDa
115 kDa
80 kDa
65 kDa
50 kDa
UT-A1
UT-A3
35 kDa
30 kDa
25 kDa
15 kDa
10 kDa
GAPDH


Relative medullary UT-A protein expression
0
0.4
0.8
1.2
1.6
n. s.
n. s.
UT-A1
UT-A3
Control
Grhl2 CD -/-

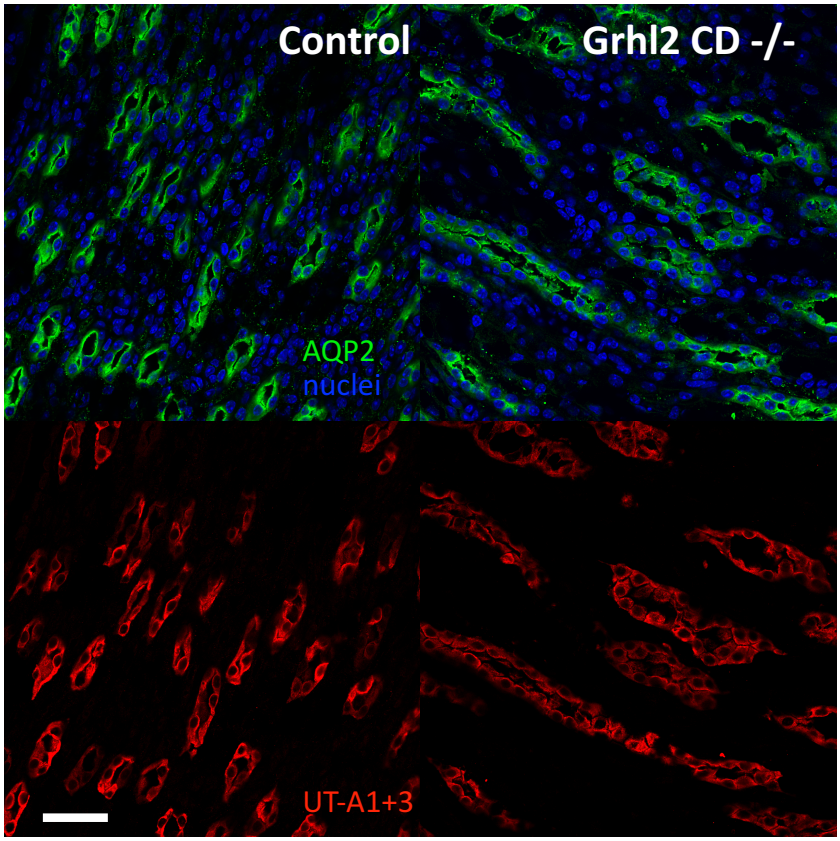

Control
Grhl2 CD -/-
AQP2
nuclei
UT-A1+3

Fig. S16: Western blots and immunofluorescence staining on medullas for urea transporters UT-A1 and 3. The upper panel shows western blots using an antibody against the N-terminal end of UT-A1 and UT-A3. The lower panel shows IF of UT-A1 and UT-A3 in 24h-thirsted inner medullary collecting ducts using the same antibody. Scale bar: 50 μm.

Supplemental Tables

Supplemental Table S1: Table showing differentially expressed genes from microarray data.

		Averages			
Gene symbol	**Entrez ID**	**Control**	***Grhl2*** $^{CD\ -/-}$	**Fold change Control/** ***Grhl2*** $^{CD\ -/-}$	**p-value t-test**
Prom2	192212	276.5	117.1	2.36	0.03363
Il17re	57890	326.4	157.3	2.08	0.00112
Fxyd4	108017	2007.9	1115.2	1.80	0.00000
Muc20	224116	256.2	149.2	1.72	0.00006
Aqp4	11829	527.5	312.0	1.69	0.00297
Hmgcs2	15360	463.3	277.7	1.67	0.00319
Spnb3	20743	551.9	339.3	1.63	0.00003
Rab25	53868	681.7	443.5	1.54	0.00149
Gstm2	14863	1532.4	1014.5	1.51	0.00002
Cldn11	18417	352.1	233.5	1.51	0.00043
Nupr1	56312	1598.8	1061.8	1.51	0.00333
Muc1	17829	484.4	323.4	1.50	0.00005
Cryab	12955	2086.1	1408.1	1.48	0.00002
Cldn4	12740	596.5	409.1	1.46	0.00008
Krt23	94179	219.2	151.3	1.45	0.00000
Rab15	104886	292.4	203.7	1.44	0.00021
Ppl	19041	241.9	168.5	1.44	0.00017
Cck	12424	322.1	225.0	1.43	0.00085
Akr1b3	11677	738.5	517.8	1.43	0.00075
Aqp2	11827	1119.9	787.2	1.42	0.00046
Cyp2d26	76279	1611.0	1132.8	1.42	0.04154
Lypd2	68311	265.9	187.4	1.42	0.01956
Lamb3	16780	203.8	145.3	1.40	0.00003
Slc4a1	20533	1344.4	960.7	1.40	0.01304
Serhl	68607	520.7	373.4	1.39	0.00929
Krt18	16668	308.3	221.7	1.39	0.00011
Dsp	109620	236.8	175.1	1.35	0.00214
Srgap3	259302	266.4	197.8	1.35	0.00030
Slco4a1	108115	878.0	652.2	1.35	0.02848
Npm3	18150	222.7	167.0	1.33	0.02910
Tmem45b	235135	1205.9	905.6	1.33	0.00662

Gata2	14461	775.9	587.4	1.32	0.00019
Rab1b	76308	810.4	617.6	1.31	0.01168
Eif4a2	13682	1268.1	970.1	1.31	0.00443
2310042D19Rik	74183	305.6	234.1	1.31	0.03651
Arl6ip5	65106	741.1	571.6	1.30	0.00515
Slc13a2	20500	1486.3	1146.5	1.30	0.00194
Napsa	16541	11718.3	9042.3	1.30	0.00011
Epb4.1l4b	54357	617.2	476.6	1.30	0.00006
Rasl11a	68895	249.4	192.8	1.29	0.01090
Slc25a36	192287	553.9	428.6	1.29	0.01103
Gm106	226866	225.7	174.9	1.29	0.00002
Tcf3	21415	727.2	563.5	1.29	0.00237
Arhgdig	14570	183.0	142.2	1.29	0.00010
Cchcr1	240084	254.8	198.1	1.29	0.01267
Lgsn	14661	1095.8	852.8	1.28	0.00274
Efcab4a	213573	314.8	245.2	1.28	0.00815
1190020J12Rik	233038	2834.0	2217.0	1.28	0.04998
Upk3b	100647	214.1	167.5	1.28	0.00315
Tmem66	67887	572.9	448.3	1.28	0.01581
Psca	72373	644.1	507.8	1.27	0.03928
Hsd11b2	15484	1732.9	1366.7	1.27	0.02541
Capg	12332	448.3	354.3	1.27	0.02212
Rgs3	50780	192.4	152.3	1.26	0.00568
Acot1	26897	644.7	511.1	1.26	0.02424
Gyltl1b	228366	413.8	328.6	1.26	0.00128
Slc9a3r2	65962	1442.4	1145.6	1.26	0.00243
Acsl5	433256	1167.6	927.6	1.26	0.00820
Cst3	13010	5349.7	4255.3	1.26	0.00396
Acaa2	52538	1295.1	1031.2	1.26	0.00256
S100a13	20196	859.0	684.0	1.26	0.01360
Stap2	106766	192.5	153.4	1.26	0.00019
Pcdh12	53601	488.3	389.3	1.25	0.02593
4930504E06Rik	75007	456.8	365.0	1.25	0.00417
Elf3	13710	272.4	217.8	1.25	0.02397
Capn1	12333	230.6	184.6	1.25	0.00501
Mycbpap	104601	263.8	211.4	1.25	0.02960
B130038B15Rik	54446	344.2	275.9	1.25	0.01123
Akap1	11640	540.1	433.9	1.24	0.01387
Pmm2	54128	323.7	260.1	1.24	0.00223
Mif4gd	69674	355.9	286.2	1.24	0.01076

Ramp3	56089	235.0	188.9	1.24	0.00221
Eno1	13806	5262.5	4237.3	1.24	0.01110
Mcat	223722	969.3	780.6	1.24	0.00001
Pecam1	18613	538.0	433.6	1.24	0.01077
Sfrp1	20377	1966.5	1585.3	1.24	0.00814
Carkd	69225	1107.3	894.8	1.24	0.02362
Slc22a5	20520	229.3	185.5	1.24	0.00407
Cd82	12521	2063.3	1669.4	1.24	0.02532
Slc14a2	27411	224.6	181.8	1.24	0.01733
Sfrs5	20384	1264.6	1024.4	1.23	0.01405
Fam171a2	217219	228.2	185.0	1.23	0.00296
Pdk2	18604	938.4	762.0	1.23	0.00986
Trub2	227682	2536.1	2060.2	1.23	0.02080
Rnf208	68846	594.5	483.0	1.23	0.03620
Krt7	110310	1169.2	950.0	1.23	0.03925
Tspo	12257	1120.3	910.4	1.23	0.00788
Esrrb	26380	1491.2	1212.0	1.23	0.03449
Alox12	11684	205.0	166.7	1.23	0.00118
Ndufc2	68197	4406.7	3589.0	1.23	0.01930
Ctsa	19025	416.9	339.6	1.23	0.00869
Ivns1abp	117198	1376.2	1121.6	1.23	0.01275
Pak1	18479	189.6	154.7	1.23	0.00632
Gprc5b	64297	439.3	358.7	1.22	0.02755
Tgfbr3	21814	813.8	665.4	1.22	0.01678
Tjp3	27375	176.9	144.7	1.22	0.00455
Eng	13805	1036.7	849.0	1.22	0.00688
Lgals4	16855	448.9	367.6	1.22	0.03882
Dcxr	67880	2525.7	2068.7	1.22	0.00076
Mrpl11	66419	604.9	495.7	1.22	0.00651
Myo7a	17921	298.7	244.8	1.22	0.00711
Capn2	12334	407.1	333.9	1.22	0.00870
Ulk1	22241	517.2	424.3	1.22	0.00111
Sphk2	56632	891.7	731.8	1.22	0.00380
Tmem53	68777	920.7	756.6	1.22	0.00311
Anapc5	59008	659.2	541.7	1.22	0.02993
Ceacam1	26365	314.4	258.4	1.22	0.01082
Tinagl	94242	497.4	408.8	1.22	0.01487
Ddn	13199	259.8	213.6	1.22	0.03276
Rapgefl1	268480	169.7	139.5	1.22	0.00031
Tpd52l1	21987	330.6	272.0	1.22	0.00226

Nedd4l	83814	1226.4	1010.8	1.21	0.02102
Tmem88	67020	2713.4	2236.9	1.21	0.00160
Itga3	16400	486.3	401.2	1.21	0.00120
Pwwp2b	101631	159.6	131.7	1.21	0.00484
Ganab	14376	347.7	287.0	1.21	0.03509
Papss2	23972	595.5	491.7	1.21	0.02896
Klhl17	231003	695.0	573.9	1.21	0.03590
Scnn1a	20276	1445.1	1193.5	1.21	0.02477
4631426J05Rik	77590	561.2	463.6	1.21	0.00338
Trpc4ap	56407	478.9	395.7	1.21	0.03683
Ppp1r1b	19049	974.8	805.5	1.21	0.01162
1500034J01Rik	66498	219.9	181.9	1.21	0.03190
BC020535	228788	245.8	203.3	1.21	0.04203
Ephx1	13849	1242.8	1028.2	1.21	0.03331
Fam116b	69440	337.3	279.2	1.21	0.00039
LOC666168	666168	1826.2	1513.2	1.21	0.01345
Crip2	68337	2049.9	1699.5	1.21	0.01245
Snurf	84704	351.7	291.9	1.20	0.02494
Spr	20751	1504.4	1249.1	1.20	0.00592
Hoxd4	15436	535.2	444.6	1.20	0.00849
Itfg3	106581	1173.5	975.0	1.20	0.00688
Slc44a2	68682	701.0	582.6	1.20	0.02281
Vsig2	57276	185.9	154.5	1.20	0.00461
Arhgdib	11857	512.1	425.6	1.20	0.00244
Ap2s1	232910	2315.6	1925.3	1.20	0.00531
BC039210	234839	584.8	486.3	1.20	0.03361
Mta3	116871	436.7	363.3	1.20	0.00263
Pdxdc1	94184	423.9	352.7	1.20	0.01250
Ccbl2	229905	240.1	199.9	1.20	0.00609
Atp6v0d1	11972	781.1	650.4	1.20	0.00966
Ppox	19044	581.7	484.6	1.20	0.00244
Sympk	68188	512.7	427.2	1.20	0.00267
Mgll	23945	383.7	320.2	1.20	0.00499
Wfs1	22393	283.1	236.2	1.20	0.00975
Khk	16548	5623.4	4693.2	1.20	0.00625
Hdac5	15184	966.6	807.2	1.20	0.00289
Scnn1b	20277	1283.0	1071.4	1.20	0.00748
Tiam1	21844	280.6	234.4	1.20	0.00206
Inpp5a	212111	525.9	439.4	1.20	0.00073
Tnip2	231130	207.0	173.1	1.20	0.00765

Ptpru	19273	224.9	188.1	1.20	0.00942
Tspan6	56496	368.2	308.0	1.20	0.00246
Hdac7	56233	380.6	318.6	1.19	0.04756
Sprr1a	20753	186.0	155.7	1.19	0.04840
Sort1	20661	1508.7	1263.1	1.19	0.00740
Capn5	12337	340.8	285.5	1.19	0.04721
Ctsc	13032	166.7	139.7	1.19	0.00251
Plat	18791	1283.2	1075.5	1.19	0.02813
Bcam	57278	169.9	142.5	1.19	0.02316
Bik	12124	304.5	255.4	1.19	0.00485
Mrpl55	67212	614.0	515.0	1.19	0.01049
Plekhg3	263406	3407.4	2858.5	1.19	0.02602
Hnrnpa2b1	53379	1438.9	1207.5	1.19	0.04365
Prodh	19125	1758.8	1476.1	1.19	0.00474
Lamb2	16779	448.9	377.0	1.19	0.04023
Nphs2	170484	165.4	138.9	1.19	0.00204
Rab7	19349	237.6	199.5	1.19	0.02822
Tmem132a	98170	247.5	208.0	1.19	0.00812
Cldn15	60363	222.8	187.3	1.19	0.00470
Anxa6	11749	1312.8	1104.7	1.19	0.00092
Hr	15460	195.8	164.8	1.19	0.00341
Imp3	102462	2490.4	2096.6	1.19	0.01619
D430041B17Rik	232813	182.6	153.8	1.19	0.00109
Upk2	22269	215.6	181.6	1.19	0.04907
Egfl7	353156	791.4	667.3	1.19	0.03612
Abcf1	224742	253.7	213.9	1.19	0.04700
Spire2	234857	188.0	158.6	1.19	0.00217
Ogt	108155	332.4	280.4	1.19	0.01155
Camkk2	207565	178.5	150.6	1.19	0.01223
Ifitm2	80876	2548.6	2150.6	1.19	0.00278
Inpp5k	19062	1522.7	1285.3	1.18	0.04869
Atp6ap2	70495	441.2	372.5	1.18	0.01882
Myh10	77579	418.2	353.0	1.18	0.00568
Gart	14450	533.6	450.5	1.18	0.00027
Lsm14b	241846	199.8	168.7	1.18	0.04542
Atp2a3	53313	444.7	375.5	1.18	0.01987
Itgb4	192897	253.2	213.8	1.18	0.02466
Atp8b1	54670	268.1	226.5	1.18	0.00239
Tie1	21846	255.9	216.2	1.18	0.00981
5730437N04Rik	70544	2637.3	2229.1	1.18	0.00064

Hk1	15275	307.5	259.9	1.18	0.04205
Gpam	14732	159.4	134.8	1.18	0.00148
Plxnb2	140570	1569.8	1328.4	1.18	0.01584
Rtn4	68585	313.2	265.1	1.18	0.02966
Aox3	71724	158.9	134.5	1.18	0.00851
Kifc2	16581	309.4	261.9	1.18	0.01000
Tmem184b	223693	1190.5	1008.2	1.18	0.00808
Dbndd2	52840	1186.6	1005.2	1.18	0.01794
Exosc5	27998	530.5	449.4	1.18	0.01987
Endod1	71946	850.0	720.2	1.18	0.00522
Unc45a	101869	390.8	331.2	1.18	0.01782
Lrpprc	72416	514.4	435.9	1.18	0.01972
Tmem126b	68472	414.0	350.9	1.18	0.03411
Cldn10	58187	1660.5	1407.8	1.18	0.02215
1810008A18Rik	108707	357.3	303.1	1.18	0.02901
Sema4g	26456	321.2	272.5	1.18	0.01390
Rhbdf1	13650	1260.8	1070.0	1.18	0.00658
Wnk4	69847	553.6	469.9	1.18	0.03753
Cnksr1	194231	412.3	350.1	1.18	0.00094
Hes1	15205	557.6	473.5	1.18	0.04381
Ceacam2	26367	489.3	415.5	1.18	0.01225
Ap1m2	11768	328.0	278.6	1.18	0.00322
Pea15a	18611	162.1	137.7	1.18	0.00932
Spnb2	20742	612.6	520.5	1.18	0.04320
D630042F21Rik	330428	1345.8	1144.1	1.18	0.01376
Mid1ip1	68041	580.6	494.0	1.18	0.01430
Dlg3	53310	481.7	409.9	1.18	0.00880
Naca	17938	832.1	708.2	1.17	0.00163
Sema7a	20361	234.4	199.6	1.17	0.03417
Slc22a13	102570	1584.7	1349.3	1.17	0.00770
Tmem9b	56786	508.9	433.5	1.17	0.04236
Emd	13726	255.9	218.2	1.17	0.00866
1110012J17Rik	68617	259.6	221.3	1.17	0.02505
Elac1	114615	154.3	131.6	1.17	0.00143
1110007L15Rik	67604	696.3	594.0	1.17	0.02285
Inppl1	16332	286.0	244.0	1.17	0.00621
Nagk	56174	1001.2	854.3	1.17	0.00261
Ift172	67661	299.0	255.3	1.17	0.01085
Atf7ip	54343	437.5	373.5	1.17	0.01337
Ppp1r9b	217124	399.9	341.5	1.17	0.00094

Shroom3	27428	226.3	193.3	1.17	0.02654
Zfp710	209225	361.2	308.6	1.17	0.03954
2310037I24Rik	69612	216.4	184.9	1.17	0.00762
Crebl2	232430	230.0	196.7	1.17	0.00159
Trim34	94094	161.6	138.5	1.17	0.01562
Cdc42ep5	58804	304.5	260.8	1.17	0.00399
Hnrnpf	98758	373.0	319.6	1.17	0.02434
Acad8	66948	307.6	263.6	1.17	0.04378
Hnrnph1	59013	1274.2	1092.0	1.17	0.01639
Smtnl2	276829	432.7	370.8	1.17	0.02135
BC040758	268663	393.6	337.4	1.17	0.02299
Prpf40b	54614	496.4	425.4	1.17	0.02306
Hist1h4i	319158	219.7	188.3	1.17	0.04797
Cldn19	242653	503.1	431.4	1.17	0.00504
Igf2r	16004	698.9	599.3	1.17	0.00975
Rhpn2	52428	255.8	219.4	1.17	0.03269
Plvap	84094	2203.9	1890.6	1.17	0.03534
Myo5c	208943	250.5	214.9	1.17	0.01388
Hmg20b	15353	501.9	430.7	1.17	0.00111
Hnrpa1	15382	406.2	348.5	1.17	0.02218
Spna2	20740	168.2	144.3	1.17	0.00338
Slc25a19	67283	270.8	232.3	1.17	0.03992
C1qtnf4	67445	280.3	240.5	1.17	0.03776
Lpin3	64899	177.2	152.2	1.16	0.00053
Hist1h4j	319159	239.0	205.3	1.16	0.04022
Golga7	57437	304.8	261.9	1.16	0.03225
Pak6	214230	150.4	129.2	1.16	0.00227
Slc5a2	246787	1420.2	1220.0	1.16	0.03492
Arl2bp	107566	716.1	615.4	1.16	0.00321
Rnf123	84585	241.9	208.0	1.16	0.01045
2310067B10Rik	71947	462.2	397.4	1.16	0.04054
Arhgef18	102098	1237.3	1063.7	1.16	0.02112
Tmem180	75146	373.5	321.1	1.16	0.00397
P2ry14	140795	311.8	268.1	1.16	0.02436
Lysmd1	217779	580.7	499.6	1.16	0.00430
Setd5	72895	353.2	304.0	1.16	0.02710
LOC667370	667370	198.2	170.6	1.16	0.04509
Gstm7	68312	203.1	174.8	1.16	0.04787
Hdhd2	76987	248.9	214.3	1.16	0.02557
Umps	22247	276.5	238.1	1.16	0.00143

A830007P12Rik	227612	279.7	240.9	1.16	0.02984
Cacnb3	12297	212.1	182.8	1.16	0.00529
Cgnl1	68178	284.9	245.5	1.16	0.00004
Arfgap2	77038	580.2	500.1	1.16	0.04315
Npal3	74552	283.7	244.5	1.16	0.01402
Sncg	20618	225.7	194.9	1.16	0.02053
Wnt7b	22422	152.9	132.0	1.16	0.01872
Clip2	269713	451.6	389.9	1.16	0.03933
Fam102a	98952	1644.4	1420.3	1.16	0.02294
Upk3a	22270	169.5	146.4	1.16	0.01557
Rsad1	237926	285.0	246.3	1.16	0.00355
Lcn2	16819	189.5	163.7	1.16	0.02848
Zzef1	195018	204.0	176.2	1.16	0.03186
Hoxd9	15438	976.6	844.6	1.16	0.04300
Phactr1	218194	268.0	231.9	1.16	0.03274
Cab39l	69008	906.1	784.2	1.16	0.00008
Bckdha	12039	3147.1	2723.9	1.16	0.00720
Ddx5	13207	201.9	174.8	1.16	0.03521
Krt8	16691	1661.8	1438.5	1.16	0.03616
Idh3g	15929	2189.2	1895.4	1.15	0.02294
Surf1	20930	419.1	362.9	1.15	0.00429
Dapk3	13144	288.8	250.1	1.15	0.03301
Lama5	16776	527.4	456.9	1.15	0.02192
Ncald	52589	213.6	185.0	1.15	0.03775
Dhx34	71723	260.2	225.6	1.15	0.03565
2510039O18Rik	77034	432.9	375.4	1.15	0.04118
Arhgef15	442801	559.8	485.4	1.15	0.04476
Rtn1	104001	209.1	181.4	1.15	0.00753
Fus	233908	184.3	159.9	1.15	0.01473
Recql5	170472	165.5	143.6	1.15	0.00221
Prelp	116847	1202.4	1043.4	1.15	0.01696
Sept1	54204	181.2	157.3	1.15	0.03318
Rarg	19411	160.2	139.1	1.15	0.02142
Uqcrc1	22273	6539.0	5678.8	1.15	0.00166
Arrb1	109689	297.2	258.2	1.15	0.04388
Tha1	71776	383.4	333.0	1.15	0.01110
Fam110a	73847	288.9	251.1	1.15	0.00067
Tprgl	67808	238.0	207.0	1.15	0.02893
Wipi1	52639	659.8	573.8	1.15	0.02571
B4galt6	56386	201.9	175.6	1.15	0.00666

Elmo3	234683	218.5	190.1	1.15	0.00535
Tsc22d4	78829	297.0	258.5	1.15	0.00212
Dnm1l	74006	858.1	747.1	1.15	0.00585
Hspb1	15507	420.1	365.8	1.15	0.03198
Fbxl11	225876	1605.5	1397.7	1.15	0.02962
Scamp5	56807	152.8	133.0	1.15	0.00014
Fpgs	14287	286.8	249.7	1.15	0.04887
Ppp1r11	76497	663.3	577.6	1.15	0.00166
Gtf3a	66596	587.3	511.4	1.15	0.03161
Chchd8	68185	382.5	333.1	1.15	0.00810
Mtx1	17827	945.4	823.7	1.15	0.01355
Sigirr	24058	747.5	651.3	1.15	0.04425
Usp19	71472	327.7	285.6	1.15	0.01407
1200003I07Rik	66869	473.8	412.9	1.15	0.01371
Spint2	20733	176.1	153.4	1.15	0.00376
Adam15	11490	586.0	510.7	1.15	0.00986
Cnot1	234594	304.0	265.0	1.15	0.04347
Tnfaip2	21928	356.2	310.7	1.15	0.00806
Tln2	70549	616.9	538.0	1.15	0.03933
1700052K11Rik	73431	210.6	183.7	1.15	0.04044
Epb4.1	269587	297.4	259.4	1.15	0.04985
Mrps10	64657	484.4	422.7	1.15	0.00832
Rilpl1	75695	694.9	606.5	1.15	0.03218
Mon1a	72825	342.4	298.9	1.15	0.03110
Ormdl3	66612	858.1	749.0	1.15	0.02540
2310033K02Rik	69553	203.6	177.8	1.15	0.04744
Ccdc130	67736	426.7	372.7	1.14	0.00014
Tmbim1	69660	242.9	212.1	1.14	0.01077
Cops4	26891	285.3	249.2	1.14	0.03744
Cdc42bpb	217866	1011.7	884.0	1.14	0.00908
Lrrk1	233328	363.1	317.4	1.14	0.00259
Gripap1	54645	681.3	595.8	1.14	0.00416
Capzb	12345	701.5	613.6	1.14	0.03101
Pxn	19303	479.7	419.6	1.14	0.00710
Dnmbp	71972	147.7	129.2	1.14	0.00958
AW146242	232023	214.3	187.5	1.14	0.01387
Ctsf	56464	691.9	605.4	1.14	0.00916
Acaa1b	235674	6572.5	5751.5	1.14	0.01120
Aldh4a1	212647	8365.9	7321.0	1.14	0.00799
Fbxw7	50754	305.7	267.5	1.14	0.02265

Ttc3	22129	1721.8	1507.0	1.14	0.00386
Vps25	28084	1342.1	1174.9	1.14	0.01614
1190005F20Rik	98685	197.4	172.8	1.14	0.01238
B3galnt2	97884	208.4	182.4	1.14	0.00812
Hlx	15284	155.7	136.3	1.14	0.00734
H2-Q8	15019	263.2	230.5	1.14	0.04921
Zfp703	353310	223.9	196.1	1.14	0.01730
Nbl1	17965	397.4	348.1	1.14	0.01388
Prmt6	99890	198.0	173.4	1.14	0.00749
Sh3bp5l	79566	1081.1	946.9	1.14	0.04715
Cpne8	66871	166.5	145.9	1.14	0.00763
Tnfrsf22	79202	177.0	155.1	1.14	0.02489
Lars	107045	485.5	425.5	1.14	0.00693
Epn2	13855	175.7	154.2	1.14	0.01208
2310007F21Rik	66939	178.2	156.4	1.14	0.00596
Nos3	18127	205.2	180.1	1.14	0.02587
Ubl7	69459	1162.8	1020.7	1.14	0.00904
Tbx2	21385	455.6	399.9	1.14	0.00438
B4galnt1	14421	185.6	162.9	1.14	0.02277
Slc16a13	69309	513.6	450.9	1.14	0.02869
Cyp4f13	170716	813.0	714.1	1.14	0.04916
Zmat5	67178	579.3	509.1	1.14	0.00433
2410001C21Rik	66404	478.9	420.9	1.14	0.04449
Fgfr3	14184	182.8	160.7	1.14	0.00246
Prickle1	106042	149.9	131.8	1.14	0.00875
Ap3d1	11776	1346.1	1183.5	1.14	0.00827
Tmem184a	231832	539.7	474.6	1.14	0.01357
Mal	17153	1024.3	901.2	1.14	0.00071
Atp9b	50771	456.3	401.5	1.14	0.04469
Sorbs1	20411	184.8	162.6	1.14	0.03361
Gimap1	16205	490.7	431.8	1.14	0.04308
Vpreb1	22362	194.8	171.5	1.14	0.01377
Ihpk1	27399	1377.4	1212.6	1.14	0.02849
Rnf25	57751	292.2	257.3	1.14	0.04084
Fastk	66587	963.1	848.2	1.14	0.00585
Efna4	13639	154.3	135.9	1.14	0.00045
BC029214	227622	247.3	217.9	1.14	0.02614
Ccdc120	54648	273.7	241.2	1.13	0.03141
Znrd1	66136	541.8	477.7	1.13	0.02670
Rab5a	271457	699.4	616.7	1.13	0.02682

Fech	14151	219.1	193.2	1.13	0.03522
Zfp330	30932	502.5	443.1	1.13	0.04226
5730472N09Rik	108958	656.6	579.1	1.13	0.02925
Bckdk	12041	1314.1	1159.1	1.13	0.03410
4933424B01Rik	71177	232.6	205.1	1.13	0.00482
Golt1a	68338	346.5	305.7	1.13	0.02873
Rgl3	71746	240.3	212.1	1.13	0.03070
Crim2	333088	322.2	284.3	1.13	0.01295
Arhgef2	16800	208.3	183.8	1.13	0.00636
Slmap	83997	183.0	161.5	1.13	0.04329
Ncdn	26562	366.0	323.1	1.13	0.02506
Pcyt2	68671	747.1	659.4	1.13	0.03042
Ddx41	72935	948.1	837.0	1.13	0.02348
Prkcd	18753	870.0	768.0	1.13	0.01373
B3gnt9	97440	209.6	185.1	1.13	0.04753
Rufy1	216724	500.6	442.3	1.13	0.03519
2310014H01Rik	76448	531.2	469.4	1.13	0.03312
Prnpip1	140546	206.1	182.1	1.13	0.03197
Tmem101	76547	261.6	231.2	1.13	0.00084
Asb3	65257	160.9	142.2	1.13	0.00486
Stab2	192188	182.1	161.0	1.13	0.03560
March2	224703	711.1	628.7	1.13	0.02051
1300010F03Rik	219189	826.2	730.6	1.13	0.02942
9130404D08Rik	74549	443.3	392.0	1.13	0.01860
Tnrc15	227331	155.4	137.4	1.13	0.02649
Ruvbl2	20174	389.6	344.5	1.13	0.00413
Uqcr	66594	8987.1	7954.8	1.13	0.00655
1200003C05Rik	104771	645.5	571.4	1.13	0.01413
Tmem115	56395	558.2	494.1	1.13	0.01066
Fntb	110606	538.2	476.5	1.13	0.03658
Tollip	54473	270.9	239.9	1.13	0.02271
Sirt3	64384	2173.3	1924.6	1.13	0.02241
Smtn	29856	1502.0	1330.1	1.13	0.00578
EG434402	434402	2270.2	2010.5	1.13	0.00153
Nrarp	67122	295.8	262.0	1.13	0.00343
Timp2	21858	1395.6	1236.2	1.13	0.04254
Laptm4a	17775	2563.2	2270.7	1.13	0.03158
Slc35a4	67843	1108.5	982.1	1.13	0.04153
Rhpn1	14787	297.7	263.8	1.13	0.03023
Echdc3	67856	336.8	298.4	1.13	0.01114

Ndufs2	226646	2331.9	2066.4	1.13	0.04108
Cwf19l1	72502	448.7	397.7	1.13	0.00122
Nucb1	18220	1686.8	1495.4	1.13	0.04258
Rpp21	67676	1403.5	1244.5	1.13	0.00151
Ptbp1	19205	1731.2	1535.2	1.13	0.00619
Fastkd1	320720	320.5	284.2	1.13	0.00120
Elmod3	232089	170.1	150.8	1.13	0.00604
Axin2	12006	164.4	145.8	1.13	0.01718
Ppm1f	68606	691.8	614.0	1.13	0.04673
Bin1	30948	445.8	395.7	1.13	0.02691
Btg1	12226	2591.1	2300.4	1.13	0.04316
Vamp5	53620	210.2	186.7	1.13	0.01644
Rad51l3	19364	153.7	136.4	1.13	0.00800
Gins4	109145	769.3	683.2	1.13	0.02352
Scel	64929	180.4	160.2	1.13	0.00173
Pla2g15	192654	458.5	407.4	1.13	0.03865
Mrpl9	78523	846.9	752.7	1.13	0.01135
H2afj	232440	611.4	543.5	1.13	0.02760
Ppp2r3a	19054	153.7	136.6	1.12	0.01103
Prmt7	214572	188.1	167.3	1.12	0.01021
BC031181	407819	2048.7	1821.5	1.12	0.02417
Ankrd40	71452	256.0	227.6	1.12	0.02143
Adar	56417	151.5	134.7	1.12	0.00040
Fbxo2	230904	158.2	140.7	1.12	0.04228
Ccnd3	12445	170.5	151.7	1.12	0.01679
Med15	94112	454.9	404.6	1.12	0.03685
Zfp707	69020	314.7	280.0	1.12	0.04872
Muted	17828	702.1	624.6	1.12	0.04256
Prkcz	18762	971.6	864.5	1.12	0.01402
Evc2	68525	733.2	653.1	1.12	0.00869
Sf4	70616	1012.6	902.1	1.12	0.02966
2810003C17Rik	108897	3929.2	3500.7	1.12	0.02691
Mtap7d1	245877	256.4	228.5	1.12	0.01861
Stk19	54402	264.9	236.1	1.12	0.02185
Vwce	71768	173.3	154.4	1.12	0.01212
Bnip1	224630	298.0	265.6	1.12	0.02880
Gcs1	57377	529.1	471.6	1.12	0.03048
Klhdc1	271005	160.1	142.7	1.12	0.00440
Pdlim2	213019	150.8	134.4	1.12	0.03100
0610007P14Rik	58520	426.5	380.3	1.12	0.01352

Tmem106c	380967	715.2	637.7	1.12	0.00210
Plekha2	83436	837.1	746.4	1.12	0.02446
Napa	108124	188.8	168.4	1.12	0.03209
Hemk1	69536	406.3	362.3	1.12	0.04784
H13	14950	771.9	688.4	1.12	0.04521
Trip10	106628	384.1	342.5	1.12	0.04390
Rnf4	19822	207.7	185.2	1.12	0.04436
Pcsk4	18551	180.2	160.7	1.12	0.02824
Gadd45a	13197	957.9	854.4	1.12	0.04027
Fam129b	227737	814.7	726.7	1.12	0.02951
Ell	13716	616.7	550.1	1.12	0.04733
Fa2h	338521	468.1	417.6	1.12	0.02408
Stab1	192187	549.2	490.3	1.12	0.04271
Nr1h2	22260	914.8	816.7	1.12	0.01640
Prkch	18755	174.1	155.4	1.12	0.02252
Gpr182	11536	185.4	165.5	1.12	0.03153
Gnb5	14697	315.3	281.6	1.12	0.03503
Rab11b	19326	5243.7	4684.5	1.12	0.01496
Ankrd39	109346	222.7	199.0	1.12	0.01811
Kng2	385643	3994.0	3569.6	1.12	0.01954
Cyb5d2	192986	180.0	160.9	1.12	0.01001
Tmem102	380705	181.1	161.9	1.12	0.02307
Tnnt1	21955	148.6	132.8	1.12	0.00459
Nomo1	211548	786.4	703.0	1.12	0.02873
D15Wsu169e	223666	234.1	209.3	1.12	0.03344
5930434B04Rik	381356	165.7	148.2	1.12	0.01915
Tdg	21665	197.1	176.3	1.12	0.04966
Gngt2	14710	268.8	240.5	1.12	0.02182
Slc1a1	20510	2416.9	2163.0	1.12	0.01797
Shmt2	108037	173.9	155.7	1.12	0.03659
Gpx4	625249	149.5	133.8	1.12	0.00119
Josd1	74158	823.2	737.0	1.12	0.02657
Gosr2	56494	302.9	271.2	1.12	0.01171
Use1	67023	551.0	493.3	1.12	0.02985
Kif12	16552	634.6	568.3	1.12	0.02984
Ogfod2	66627	172.5	154.5	1.12	0.03964
B3gat3	72727	226.2	202.6	1.12	0.03049
Glt8d1	76485	224.4	201.0	1.12	0.01906
Hps1	192236	284.6	255.0	1.12	0.00912
Zw10	26951	283.9	254.4	1.12	0.02393

Stard10	56018	4069.0	3646.6	1.12	0.03870
Nelf	56876	631.3	565.8	1.12	0.01707
Klc1	16593	298.5	267.6	1.12	0.00467
Pcbd2	72562	1841.7	1651.2	1.12	0.00512
Stx5a	56389	2209.1	1981.4	1.11	0.01469
Gprk6	26385	161.3	144.7	1.11	0.03496
Peo1	226153	166.9	149.7	1.11	0.01310
Usf2	22282	206.4	185.2	1.11	0.04163
Pld3	18807	492.4	441.7	1.11	0.03069
Acot2	171210	213.5	191.5	1.11	0.00337
Srp54	24067	197.2	176.9	1.11	0.02192
Etfdh	66841	1576.2	1414.3	1.11	0.02126
Cd59b	333883	616.0	552.7	1.11	0.02928
Slc35f2	72022	177.0	158.9	1.11	0.01282
Fam100b	319370	199.0	178.6	1.11	0.00118
Impdh1	23917	228.2	204.8	1.11	0.01048
Syf2	68592	1229.9	1103.9	1.11	0.02351
Dctn6	22428	798.0	716.3	1.11	0.00995
BC057627	330474	304.9	273.7	1.11	0.01464
Elp3	74195	753.7	676.6	1.11	0.01524
Mtif3	76366	385.0	345.7	1.11	0.01361
9530068E07Rik	213673	2215.1	1989.0	1.11	0.02723
Aatf	56321	269.3	241.8	1.11	0.00375
1810043H04Rik	208501	755.4	678.5	1.11	0.01135
Acot8	170789	1130.7	1015.8	1.11	0.03819
Asph	65973	145.9	131.1	1.11	0.00435
Ppap2c	50784	2414.3	2169.9	1.11	0.01682
Ehmt2	110147	773.1	694.9	1.11	0.04031
Foxred1	235169	163.9	147.4	1.11	0.01159
Ercc2	13871	222.9	200.3	1.11	0.04736
Fars2	69955	1748.9	1572.3	1.11	0.04977
Napepld	242864	220.5	198.2	1.11	0.00721
Dusp28	67446	334.6	300.8	1.11	0.00112
Gpsn2	106529	3052.7	2745.5	1.11	0.00501
Atic	108147	166.1	149.4	1.11	0.02999
Pcdh1	75599	389.1	350.1	1.11	0.04999
Ermp1	226090	1140.0	1025.6	1.11	0.00323
Taz	66826	970.8	873.5	1.11	0.00457
Mapk15	332110	141.5	127.3	1.11	0.00266
Rbms2	56516	165.0	148.5	1.11	0.00427

Adcy4	104110	355.4	319.9	1.11	0.04962
Rac3	170758	145.5	130.9	1.11	0.00425
Sox13	20668	310.0	279.1	1.11	0.03982
Mxd4	17122	218.6	196.9	1.11	0.04597
Rnf31	268749	238.2	214.6	1.11	0.04470
Nsmaf	18201	361.6	325.8	1.11	0.03986
Mtmr14	97287	166.3	149.9	1.11	0.02064
Dgkq	110524	1216.6	1096.6	1.11	0.01258
Zfp524	66056	363.7	327.9	1.11	0.03964
Gmppa	69080	199.4	179.7	1.11	0.02398
Acsf3	257633	570.7	514.6	1.11	0.02976
Dci	13177	2170.4	1957.0	1.11	0.01375
Uck1	22245	203.4	183.4	1.11	0.02188
Extl3	54616	560.1	505.3	1.11	0.01381
Ovol2	107586	155.9	140.7	1.11	0.01166
BC023744	231668	372.9	336.6	1.11	0.04252
Zfp161	22666	226.2	204.3	1.11	0.03351
Gusb	110006	179.7	162.3	1.11	0.03190
Bola3	78653	2244.2	2027.0	1.11	0.04728
Plekhg6	213522	143.7	129.8	1.11	0.00181
Hps4	192232	192.4	173.9	1.11	0.02427
Mus81	71711	150.8	136.3	1.11	0.00420
Xrcc1	22594	419.8	379.5	1.11	0.01774
Cep110	26920	165.8	149.9	1.11	0.00735
Cd81	12520	7105.5	6424.7	1.11	0.01320
Ppp1r13b	21981	460.8	416.6	1.11	0.03309
Flcn	216805	193.4	174.9	1.11	0.00142
Cd97	26364	362.8	328.1	1.11	0.02446
Drg2	13495	620.5	561.2	1.11	0.01152
Slc44a1	100434	269.7	243.9	1.11	0.01343
Cyb561d2	56368	202.7	183.3	1.11	0.00220
2410006H16Rik	69221	271.6	245.8	1.11	0.03657
Kat2a	14534	278.3	251.8	1.11	0.01197
Smcr7l	239555	252.1	228.1	1.11	0.01005
Atp2a2	11938	2285.2	2067.7	1.11	0.02344
Klhl24	75785	184.6	167.1	1.11	0.03670
2700046G09Rik	67188	561.2	507.9	1.10	0.04370
Cdipt	52858	2159.7	1955.5	1.10	0.02033
Ccdc62	208908	151.9	137.6	1.10	0.00326
Rab35	77407	1011.7	916.4	1.10	0.02704

Psmb3	26446	2896.1	2623.3	1.10	0.03498
Hip1r	29816	281.0	254.6	1.10	0.01986
Fis1	66437	1970.2	1785.2	1.10	0.02879
Hspa9	15526	3689.9	3343.8	1.10	0.03277
Sbno1	243272	166.7	151.1	1.10	0.02068
2610204M08Rik	70435	157.6	142.9	1.10	0.04202
Gpr107	277463	467.7	424.1	1.10	0.01917
9430015G10Rik	230996	155.9	141.4	1.10	0.03233
Sept11	52398	2768.8	2511.1	1.10	0.03736
Sox7	20680	203.1	184.2	1.10	0.04479
Asna1	56495	2056.7	1865.5	1.10	0.03471
Rassf7	66985	481.8	437.3	1.10	0.00098
Csnk1g2	103236	441.5	400.8	1.10	0.00630
Ociad1	68095	3113.3	2826.5	1.10	0.03245
Psenen	66340	2322.2	2108.9	1.10	0.03924
Pop5	117109	3650.1	3316.1	1.10	0.03821
Grip1	74053	240.9	218.8	1.10	0.02674
Gtf3c1	233863	704.1	639.9	1.10	0.02045
Rdbp	27632	532.3	483.8	1.10	0.01686
Lcmt1	30949	175.0	159.2	1.10	0.02433
Gm1027	381538	142.4	129.5	1.10	0.03482
Nosip	66394	214.4	195.1	1.10	0.01854
Mthfsd	234814	170.3	155.0	1.10	0.03325
Xpnpep2	170745	147.6	134.4	1.10	0.03319
Pitx2	18741	183.6	167.2	1.10	0.03595
Dock9	105445	152.8	139.1	1.10	0.01779
Pde6d	18582	602.2	548.5	1.10	0.02364
Wars	22375	189.9	173.0	1.10	0.02574
Dedd	21945	164.9	150.2	1.10	0.04345
Cox17	12856	3837.1	3496.7	1.10	0.00909
Tk2	57813	570.2	519.6	1.10	0.04643
Ints5	109077	282.5	257.5	1.10	0.01972
Hdac8	70315	166.8	152.1	1.10	0.04091
Rnf167	70510	304.9	278.1	1.10	0.01495
Peg13	353342	278.1	253.6	1.10	0.03573
Fam151a	230579	580.3	529.3	1.10	0.03991
Fdxr	14149	154.8	141.2	1.10	0.03886
Lrrc51	69358	240.5	219.4	1.10	0.02824
Apoa1bp	246703	1770.4	1615.1	1.10	0.00691
Dvl1	13542	152.8	139.4	1.10	0.02871

Coq6	217707	953.4	869.8	1.10	0.00734
Smg7	226517	1524.3	1390.7	1.10	0.04998
X99384	27355	321.8	293.8	1.10	0.04741
Tpst2	22022	584.6	533.7	1.10	0.00538
Ggcx	56316	226.2	206.6	1.10	0.04829
Galnt10	171212	217.3	198.4	1.10	0.01782
Rab43	69834	244.5	223.3	1.10	0.01352
Sqstm1	18412	2726.6	2490.5	1.09	0.00241
B3gnt8	232984	182.2	166.4	1.09	0.00708
Dyrk2	69181	152.2	139.0	1.09	0.02139
2210018M11Rik	233545	156.8	143.3	1.09	0.04880
Mrps12	24030	2532.8	2314.8	1.09	0.01406
Gltscr2	68077	907.1	829.1	1.09	0.02150
Zhx2	387609	296.3	270.9	1.09	0.02902
Khdrbs3	13992	201.0	183.7	1.09	0.01263
Wbp1	22377	514.8	470.7	1.09	0.01256
Bcl2	12043	164.3	150.2	1.09	0.02899
Ift52	245866	931.3	851.5	1.09	0.02777
Sp1	20683	207.1	189.4	1.09	0.03747
Erlin2	244373	154.1	141.0	1.09	0.00677
Tymp	72962	152.8	139.8	1.09	0.00669
Zfp219	69890	389.7	356.7	1.09	0.02378
Copz1	56447	2295.7	2101.2	1.09	0.01761
Ddhd1	114874	155.6	142.4	1.09	0.02851
C85492	215494	420.8	385.1	1.09	0.01484
Zfp316	54201	142.1	130.1	1.09	0.01308
Gtpbp10	207704	161.7	148.0	1.09	0.02430
Zfyve27	319740	227.7	208.5	1.09	0.00488
Kat5	81601	284.4	260.4	1.09	0.00944
Map3k7ip1	66513	156.2	143.0	1.09	0.00275
Zfyve26	211978	433.0	396.5	1.09	0.04244
Taf11	68776	263.5	241.3	1.09	0.02312
Hexdc	238023	411.3	376.8	1.09	0.03400
Slc25a38	208638	502.0	459.8	1.09	0.03729
Cog2	76332	288.6	264.4	1.09	0.01960
Srebf2	20788	303.2	277.8	1.09	0.04907
Slc39a3	106947	170.1	155.9	1.09	0.04281
Rabggtb	19352	171.1	156.8	1.09	0.00886
C030048B08Rik	269623	159.7	146.4	1.09	0.03933
1700084E18Rik	67350	146.7	134.5	1.09	0.01011

Mbtps1	56453	340.7	312.5	1.09	0.04898
Sf3b4	107701	1047.1	960.7	1.09	0.03726
AI894139	101197	178.5	163.8	1.09	0.03828
Ndor1	78797	230.9	211.9	1.09	0.02468
Mfng	17305	161.4	148.2	1.09	0.04215
Dysf	26903	160.8	147.7	1.09	0.04025
Slc25a5	11740	12077.5	11100.4	1.09	0.02758
Tarsl2	272396	168.2	154.6	1.09	0.01128
BC059842	230676	207.2	190.4	1.09	0.02408
Taf9b	407786	203.8	187.3	1.09	0.04307
Pigq	14755	1693.7	1557.2	1.09	0.01615
Ak3	56248	2479.8	2280.4	1.09	0.03114
Nupl1	71844	221.4	203.6	1.09	0.00664
Foxk1	17425	148.0	136.2	1.09	0.03612
Ick	56542	186.9	172.0	1.09	0.01718
Pold4	69745	319.9	294.4	1.09	0.00731
1110034G24Rik	73747	139.6	128.5	1.09	0.00558
Snta1	20648	824.0	758.7	1.09	0.03271
Atxn3	110616	193.7	178.4	1.09	0.01134
Idua	15932	229.5	211.3	1.09	0.03948
B3galt4	54218	150.0	138.1	1.09	0.02722
Tsc2	22084	138.6	127.6	1.09	0.04960
Mapk9	26420	211.6	195.0	1.09	0.00260
Ikbkg	16151	166.0	153.0	1.09	0.01895
Swap70	20947	207.0	190.9	1.08	0.01920
1190007F08Rik	68859	1668.0	1537.9	1.08	0.03071
Ppp1r12c	232807	139.9	129.0	1.08	0.02165
Nle1	217011	162.9	150.2	1.08	0.01225
Mknk1	17346	473.6	436.9	1.08	0.02155
Casr	12374	178.6	164.9	1.08	0.03696
Ap2b1	71770	157.7	145.6	1.08	0.00845
Aqr	11834	143.5	132.5	1.08	0.00479
Apoa2	11807	281.7	260.1	1.08	0.02612
Wwox	80707	138.9	128.3	1.08	0.00504
Tm2d3	68634	234.4	216.6	1.08	0.02394
Pop1	67724	145.8	134.7	1.08	0.01096
1500011B03Rik	66236	188.8	174.5	1.08	0.00952
Wdr93	626359	136.5	126.2	1.08	0.01512
6330549D23Rik	229613	153.3	141.8	1.08	0.01573
Numb	18222	142.2	131.7	1.08	0.04237

Vps8	209018	135.5	125.5	1.08	0.00264
Tbc1d1	57915	286.5	265.5	1.08	0.03142
Cbx2	12416	143.7	133.2	1.08	0.04200
Esrra	26379	1915.9	1777.0	1.08	0.03241
1600002K03Rik	69770	281.2	261.0	1.08	0.01811
1810043G02Rik	67884	237.2	220.2	1.08	0.00418
4632417N05Rik	74032	142.3	132.1	1.08	0.02693
Uba5	66663	963.8	895.5	1.08	0.04642
Ppp2r2c	269643	164.7	153.2	1.08	0.02163
Ndufs3	68349	3838.5	3571.1	1.07	0.03212
Statip1	58523	1105.1	1028.1	1.07	0.02978
Fkbpl	56299	154.8	144.1	1.07	0.03410
Dmap1	66233	393.9	366.9	1.07	0.03133
Stard3	59045	224.4	209.1	1.07	0.04103
Trim3	55992	179.5	167.4	1.07	0.03659
Ints7	77065	393.6	367.1	1.07	0.04308
Mapk12	29857	144.7	134.9	1.07	0.03231
Rag1ap1	19729	399.0	372.3	1.07	0.03060
Usp30	100756	215.9	201.4	1.07	0.00119
Mnat1	17420	327.8	306.0	1.07	0.03510
Phka2	110094	311.4	290.8	1.07	0.02960
Kif16b	16558	142.6	133.2	1.07	0.01745
Vps33a	77573	689.5	644.0	1.07	0.03970
Ift140	106633	237.6	222.0	1.07	0.03453
D11Wsu99e	28081	168.0	157.1	1.07	0.03692
Mrgprf	211577	154.7	144.6	1.07	0.02960
1700123D08Rik	76646	169.3	158.3	1.07	0.02789
D030016E14Rik	320714	171.5	160.4	1.07	0.02291
Phgdh	236539	150.6	140.8	1.07	0.01132
Edem2	108687	143.2	134.0	1.07	0.01675
Lamc3	23928	203.8	190.7	1.07	0.02922
Mapk1ip1	69546	212.6	199.0	1.07	0.03506
Ube2i	22196	139.9	131.0	1.07	0.04177
Rdm1	66599	795.3	744.6	1.07	0.01563
Copg2	54160	180.4	169.0	1.07	0.00317
Ticam1	106759	167.8	157.2	1.07	0.00928
Hcfc2	67933	203.0	190.2	1.07	0.01586
Zfp317	244713	145.3	136.1	1.07	0.01881
Marveld3	73608	309.1	289.8	1.07	0.04774
Vps16	80743	537.0	504.4	1.06	0.04237

Snn	20621	2192.8	2060.0	1.06	0.02263
Parp16	214424	227.0	213.5	1.06	0.01034
Limk2	16886	301.7	283.8	1.06	0.01485
Trex1	22040	217.6	205.0	1.06	0.01221
Grhl2	252973	191.2	180.1	1.06	0.03060
Mdfic	16543	141.0	132.9	1.06	0.02780
Atp2c1	235574	166.8	157.4	1.06	0.02113
Tagap1	380608	346.1	326.8	1.06	0.01971
BC066107	240066	149.7	141.4	1.06	0.04759
Exoc4	20336	396.8	374.8	1.06	0.03176
Slc39a2	214922	141.3	133.4	1.06	0.04127
Spata7	104871	135.5	128.0	1.06	0.04142
5330431N19Rik	226162	140.8	133.0	1.06	0.02410
Krr1	52705	140.7	133.2	1.06	0.02507
Lrrfip1	16978	146.5	138.7	1.06	0.01832
Ppp2r1b	73699	248.1	235.1	1.06	0.02051
Rnuxa	56698	436.3	414.1	1.05	0.02029
Gak	231580	3018.1	2866.2	1.05	0.04617
Me2	107029	136.8	129.9	1.05	0.02532
1110014N23Rik	68505	243.6	231.6	1.05	0.02063
Ptpn6	15170	144.9	137.9	1.05	0.04064
Nup88	19069	1171.7	1120.4	1.05	0.03283
Fiz1	23877	517.7	496.2	1.04	0.04340
Ppm1a	19042	1676.4	1743.6	0.96	0.02806
Ccdc41	77048	301.0	315.0	0.96	0.03584
Cog6	67542	832.1	876.9	0.95	0.03133
Rpgrip1l	244585	129.7	136.9	0.95	0.02078
Ndufv2	72900	5239.3	5535.4	0.95	0.04282
Rnf168	70238	199.8	211.2	0.95	0.03531
2610101N10Rik	67958	1112.0	1177.8	0.94	0.02915
Ssrp1	20833	619.4	657.3	0.94	0.04251
Cenpq	83815	133.9	142.3	0.94	0.02936
Acn9	71238	262.8	279.3	0.94	0.02228
2500003M10Rik	66511	2147.0	2284.5	0.94	0.00490
C8b	110382	151.1	160.8	0.94	0.03835
Snap29	67474	571.3	608.1	0.94	0.01915
Rab4a	19341	740.8	789.6	0.94	0.04807
Atp6v1b1	110935	130.5	139.1	0.94	0.02476
Setd2	235626	668.4	712.7	0.94	0.01311
G3bp2	23881	1233.7	1315.7	0.94	0.01601

1810006K21Rik	69038	1782.0	1901.4	0.94	0.03985
Atp5l	27425	9875.3	10540.3	0.94	0.02986
Kifc3	16582	193.5	206.6	0.94	0.02833
Zfp62	22720	131.0	140.0	0.94	0.01885
Tax1bp3	76281	2146.2	2294.9	0.94	0.03322
Manba	110173	1903.3	2035.4	0.94	0.02511
Armc7	276905	127.7	136.6	0.93	0.01640
Ywhab	54401	2898.9	3102.6	0.93	0.04885
Rpain	69723	153.0	163.8	0.93	0.02783
Pex1	71382	237.9	254.7	0.93	0.02658
Fam135a	68187	515.8	552.2	0.93	0.01639
Dync1i2	13427	2314.5	2478.2	0.93	0.01363
Gmps	229363	240.3	257.4	0.93	0.03787
Ybx1	22608	191.5	205.2	0.93	0.00356
Mrpl49	18120	195.4	209.6	0.93	0.02607
2810403A07Rik	74200	1892.1	2029.7	0.93	0.02664
Smo	319757	506.3	543.3	0.93	0.01295
AV249152	216560	190.1	204.0	0.93	0.02178
2810453I06Rik	67238	148.5	159.3	0.93	0.01954
Farsb	23874	1046.2	1123.0	0.93	0.04105
Cugbp1	13046	526.8	565.7	0.93	0.04063
Eif2s2	67204	738.0	792.7	0.93	0.04705
Ctage5	217615	4349.0	4673.7	0.93	0.03168
Sfrs3	20383	275.7	296.4	0.93	0.04595
Enoph1	67870	235.8	253.5	0.93	0.03700
Polr3k	67005	192.8	207.4	0.93	0.01455
Seh1l	72124	276.8	297.7	0.93	0.04243
Stx7	53331	2813.2	3027.7	0.93	0.01319
Yme1l1	27377	237.8	256.0	0.93	0.03915
March7	57438	170.5	183.7	0.93	0.04946
Nup205	70699	544.7	586.8	0.93	0.02070
Nudt16l1	66911	1426.3	1537.1	0.93	0.03236
Ncl	17975	327.2	352.6	0.93	0.04684
Atg5	11793	872.3	940.2	0.93	0.03915
BC030336	233812	242.1	261.0	0.93	0.03780
Serf2	378702	2945.2	3176.6	0.93	0.03416
Aprin	100710	338.2	364.9	0.93	0.03255
Hat1	107435	1385.5	1495.1	0.93	0.04025
Ptges3	56351	480.1	518.6	0.93	0.00817
6330503K22Rik	101565	229.6	248.0	0.93	0.02549

Phf10	72057	455.9	492.5	0.93	0.04509
Zfand2a	100494	400.3	432.6	0.93	0.03978
Cdcp1	109332	146.2	158.1	0.93	0.04637
Nme7	171567	454.8	491.9	0.92	0.04318
Rps24	20088	160.4	173.5	0.92	0.01361
Mpv17	17527	418.9	453.2	0.92	0.02240
Brca2	12190	135.5	146.7	0.92	0.02343
4933434E20Rik	99650	262.7	284.4	0.92	0.03403
Pde4dip	83679	1103.3	1194.3	0.92	0.04916
Gnptg	214505	2894.8	3134.5	0.92	0.01142
Usp1	230484	285.1	308.9	0.92	0.03453
Ehbp1	216565	138.4	150.0	0.92	0.01700
Chchd10	103172	10905.6	11819.8	0.92	0.03732
Btbd6	399566	553.2	599.8	0.92	0.02709
Rpl26	19941	4825.7	5232.7	0.92	0.02903
C030046E11Rik	226089	156.2	169.4	0.92	0.00932
Cox6b1	110323	8963.4	9723.9	0.92	0.01039
Rpl31	114641	433.5	470.8	0.92	0.00309
Ift20	55978	460.9	500.5	0.92	0.02260
Gchfr	320415	698.6	758.7	0.92	0.01495
Tmed4	103694	1764.7	1916.7	0.92	0.00532
Pbx1	18514	273.1	296.6	0.92	0.01113
Etfa	110842	4049.9	4399.1	0.92	0.01106
Cftr	12638	157.3	170.9	0.92	0.00788
Taf13	99730	364.0	395.5	0.92	0.02745
Fbxo34	78938	470.7	511.4	0.92	0.02290
Iah1	67732	1757.1	1910.0	0.92	0.04077
6230416J20Rik	230376	145.3	158.0	0.92	0.04328
Gnl3	30877	140.0	152.3	0.92	0.03677
Gpc4	14735	373.8	406.6	0.92	0.03168
Acsl4	50790	173.0	188.2	0.92	0.00377
Kctd9	105440	295.9	322.0	0.92	0.02045
A530082C11Rik	320541	205.8	224.0	0.92	0.04211
Nat12	70646	489.6	532.7	0.92	0.03018
Galnt14	71685	143.0	155.6	0.92	0.04113
2310002B06Rik	53951	504.6	549.7	0.92	0.04638
Cdc73	214498	145.5	158.5	0.92	0.04114
Lamp2	16784	5190.2	5659.4	0.92	0.00555
Degs1	13244	3906.6	4261.7	0.92	0.02535
2410002O22Rik	66975	277.4	302.7	0.92	0.04208

Zbed4	223773	173.1	188.9	0.92	0.00612
Gpr160	71862	342.1	373.4	0.92	0.02477
Tead2	21677	185.2	202.2	0.92	0.04596
Mrpl16	94063	674.2	736.0	0.92	0.03714
Fundc1	72018	808.6	882.8	0.92	0.01682
Sdhd	66925	610.8	667.0	0.92	0.03814
Pus10	74467	180.9	197.5	0.92	0.01720
Rdh10	98711	142.1	155.2	0.92	0.02284
Rbbp9	26450	1264.0	1380.5	0.92	0.00416
Csde1	229663	2393.2	2614.2	0.92	0.00346
Rab28	100972	1989.8	2175.0	0.91	0.03600
Wdr76	241627	163.4	178.8	0.91	0.00710
Sae1	56459	313.7	343.1	0.91	0.02862
Fbxo4	106052	421.2	460.8	0.91	0.03903
Dusp16	70686	430.4	470.9	0.91	0.01372
Ncbp2	68092	256.4	280.6	0.91	0.02140
Zcrb1	67197	1834.6	2008.8	0.91	0.00014
Sbf2	319934	133.2	145.8	0.91	0.02596
1110037F02Rik	66185	229.5	251.3	0.91	0.02579
5830404H04Rik	207781	323.8	354.6	0.91	0.02562
Gata6	14465	151.7	166.1	0.91	0.01607
Ryk	20187	1163.9	1275.0	0.91	0.00162
Afm	280662	398.5	436.6	0.91	0.04246
Tmbim4	68212	8839.8	9687.9	0.91	0.00380
Coro7	78885	131.7	144.4	0.91	0.01427
Narg1l	66897	287.4	315.0	0.91	0.02351
Znhit3	448850	275.0	301.5	0.91	0.03861
Cdh3	12560	145.0	159.0	0.91	0.01121
Tmem185b	226351	1193.4	1309.0	0.91	0.03469
Dnmt1	13433	234.1	256.7	0.91	0.03546
Cd164	53599	5292.2	5809.0	0.91	0.02219
Psmb2	26445	1653.2	1814.9	0.91	0.00624
Tex261	21766	699.1	767.5	0.91	0.03583
Rccd1	269955	131.2	144.1	0.91	0.00654
Cbfb	12400	771.2	847.0	0.91	0.02366
Pkp2	67451	562.3	618.1	0.91	0.00073
Ang	11727	162.6	178.8	0.91	0.00915
Tmem77	67171	305.5	335.9	0.91	0.00469
Chmp1b	67064	870.5	957.1	0.91	0.01510
1700034H14Rik	67105	919.2	1010.8	0.91	0.00018

Mphosph6	68533	247.4	272.1	0.91	0.00414
Map2k2	26396	2427.1	2669.6	0.91	0.04118
Otud6b	72201	168.4	185.3	0.91	0.02446
Mrps18c	68735	1041.8	1146.6	0.91	0.03984
Tmem5	216395	664.8	731.7	0.91	0.01363
Fancl	67030	141.6	155.9	0.91	0.00822
Kpna3	16648	141.1	155.3	0.91	0.01307
Sec22c	215474	130.7	143.9	0.91	0.01829
Iars	105148	545.5	600.8	0.91	0.01220
Brcc3	210766	133.2	146.7	0.91	0.01846
Tpp2	22019	200.2	220.6	0.91	0.04020
Crkl	12929	292.8	322.6	0.91	0.01677
5730449L18Rik	66637	448.9	494.8	0.91	0.03375
Psma2	19166	4881.5	5380.8	0.91	0.00876
Slc35a5	74102	198.5	218.9	0.91	0.00026
Tmem135	72759	199.3	219.6	0.91	0.03125
Ccnl1	56706	223.4	246.2	0.91	0.02141
Clcn3	12725	2836.2	3128.3	0.91	0.03637
1600012H06Rik	67912	165.9	183.0	0.91	0.00033
Psip1	101739	436.2	481.3	0.91	0.04836
Socs6	54607	219.5	242.2	0.91	0.00249
Hnf4a	15378	2824.6	3116.5	0.91	0.02489
Cnot6l	231464	212.7	234.7	0.91	0.00718
Mrpl13	68537	2167.1	2391.4	0.91	0.02141
Fam163a	329274	158.7	175.2	0.91	0.01989
Tmem35	67564	172.6	190.5	0.91	0.03053
2610044O15Rik	72139	142.5	157.3	0.91	0.00293
Zfand6	65098	163.6	180.6	0.91	0.00812
Srp19	66384	145.0	160.1	0.91	0.02557
Whsc2	24116	340.6	376.2	0.91	0.00694
Slc22a1	20517	6417.2	7087.5	0.91	0.01339
Bccip	66165	1648.4	1820.5	0.91	0.00206
Dpy30	66310	986.5	1089.9	0.91	0.04081
Ift74	67694	144.5	159.7	0.91	0.00591
Htatsf1	72459	1282.7	1417.9	0.90	0.01374
Dnajb9	27362	823.5	910.4	0.90	0.03341
Asb13	142688	1914.7	2117.2	0.90	0.01106
Yipf4	67864	151.4	167.4	0.90	0.02076
Pcdh7	54216	189.6	209.8	0.90	0.04324
Hnrpa0	77134	903.4	999.7	0.90	0.04597

Ei24	13663	1349.7	1493.8	0.90	0.00865
Ube2d2	56550	971.9	1075.8	0.90	0.00852
P2ry1	18441	149.9	165.9	0.90	0.01965
Slc6a6	21366	5913.9	6551.4	0.90	0.00285
Txndc13	52837	1063.7	1178.4	0.90	0.01108
Rg9mtd1	52575	305.0	337.9	0.90	0.01961
Entpd5	12499	1582.4	1753.4	0.90	0.02167
Cspp1	211660	247.1	273.9	0.90	0.02257
Psme4	103554	2462.6	2730.3	0.90	0.03735
Cnot2	72068	634.9	704.1	0.90	0.04129
Taok1	216965	1038.2	1151.4	0.90	0.02393
Mrps17	66258	1745.8	1936.4	0.90	0.01449
Mrps35	232536	1023.2	1135.3	0.90	0.02358
C730025P13Rik	227615	251.9	279.5	0.90	0.04568
Tm2d2	69742	1785.6	1981.5	0.90	0.02026
Clec1a	243653	150.6	167.2	0.90	0.02908
Zfp281	226442	296.1	328.8	0.90	0.01302
Tmem68	72098	704.6	782.5	0.90	0.03287
D5Wsu178e	28042	194.3	215.9	0.90	0.01307
Gphn	268566	634.1	704.8	0.90	0.02879
Atp6v1h	108664	2723.4	3027.4	0.90	0.00011
8430410K20Rik	78100	1067.1	1186.4	0.90	0.00369
Mrps15	66407	339.5	377.5	0.90	0.04554
Nqo2	18105	366.8	407.9	0.90	0.00727
Sdcbp	53378	1657.1	1842.9	0.90	0.02007
Taf5	226182	141.8	157.7	0.90	0.00775
Hnrpm	76936	3267.0	3634.3	0.90	0.00131
Abi1	11308	911.2	1013.8	0.90	0.00829
Adk	11534	3627.4	4036.0	0.90	0.00429
Acin1	56215	188.2	209.5	0.90	0.00357
Ffar3	233080	307.3	342.0	0.90	0.01698
Slit2	20563	580.8	646.5	0.90	0.04369
Nme1	18102	4996.2	5561.3	0.90	0.02063
4930461P20Rik	78244	964.1	1073.2	0.90	0.00585
Cachd1	320508	339.2	377.6	0.90	0.04753
Iqwd1	74106	420.6	468.2	0.90	0.03477
Eif2a	229317	1275.7	1420.3	0.90	0.02875
Cdc5l	71702	1020.4	1136.3	0.90	0.00225
Tor1aip2	240832	214.6	238.9	0.90	0.01312
Vcp	269523	4576.0	5096.0	0.90	0.00066

Tceal8	66684	930.0	1035.9	0.90	0.02388
Dynlt3	67117	1160.1	1292.4	0.90	0.01670
Tgfbr1	21812	1597.3	1780.1	0.90	0.02017
Eed	13626	249.9	278.5	0.90	0.01532
Mospd1	70380	199.6	222.5	0.90	0.04557
Msh6	17688	583.1	650.3	0.90	0.04877
Rap1b	215449	2060.0	2299.3	0.90	0.01914
Narg1	74838	393.9	439.8	0.90	0.03974
Ythdf3	229096	159.2	177.8	0.90	0.01611
Ints12	71793	237.5	265.3	0.90	0.03564
Arl4a	11861	160.6	179.3	0.90	0.04596
Chd9	109151	274.5	306.7	0.89	0.00668
Terf2	21750	362.9	405.6	0.89	0.01427
Dhx36	72162	565.4	632.7	0.89	0.02578
Tmem176b	65963	4105.7	4594.9	0.89	0.03541
2410022L05Rik	66423	496.1	555.4	0.89	0.03841
Dhx15	13204	957.1	1071.6	0.89	0.00867
Phca	66190	170.2	190.6	0.89	0.00900
Ppapdc2	74411	1133.0	1268.7	0.89	0.01703
Usp42	76800	298.7	334.5	0.89	0.00474
Ergic2	67456	252.0	282.3	0.89	0.03569
Tcerg1	56070	522.0	584.8	0.89	0.00000
Timm9	30056	2338.1	2619.5	0.89	0.02314
Polr1d	20018	1900.6	2131.3	0.89	0.02592
Atxn2	20239	2135.3	2395.1	0.89	0.04918
Mak10	78689	690.5	774.5	0.89	0.00489
Als2cr13	72750	389.7	437.1	0.89	0.03829
Tfb2m	15278	560.6	628.9	0.89	0.02847
Nt5c3	107569	821.8	921.9	0.89	0.04405
Tbca	21371	4793.0	5377.8	0.89	0.01510
Serbp1	66870	320.4	359.5	0.89	0.01074
2610204K14Rik	67148	248.7	279.3	0.89	0.00384
Rpl27a	26451	680.6	764.3	0.89	0.01103
Pi4k2b	67073	330.2	370.8	0.89	0.02741
L1td1	381591	151.0	169.6	0.89	0.00435
Fam164a	67306	699.1	785.3	0.89	0.04381
Pmpcb	73078	435.9	489.6	0.89	0.03886
Sfrs1	110809	2533.7	2848.1	0.89	0.01398
Rars2	109093	565.4	635.6	0.89	0.00445
4921505C17Rik	78757	514.6	578.6	0.89	0.02275

Srp72	66661	188.7	212.2	0.89	0.04684
Cep170	545389	242.3	272.4	0.89	0.01402
Rbm28	68272	941.2	1058.5	0.89	0.00357
Nasp	50927	217.1	244.2	0.89	0.02492
Evi5	14020	1219.1	1371.4	0.89	0.04537
Stt3b	68292	3980.0	4478.4	0.89	0.01753
Mgat3	17309	552.7	622.0	0.89	0.01922
9430016H08Rik	68115	728.7	820.1	0.89	0.00308
Fbxo9	71538	825.9	929.6	0.89	0.00314
Sepsecs	211006	160.3	180.4	0.89	0.01988
Eif5	217869	3642.7	4100.3	0.89	0.00204
Alg11	207958	128.9	145.1	0.89	0.00254
2410042D21Rik	72425	396.6	446.5	0.89	0.00493
Clic5	224796	168.5	189.8	0.89	0.00312
Mrps31	57312	1427.2	1607.4	0.89	0.00018
Wwtr1	97064	857.8	966.2	0.89	0.00651
Arhgap1	228359	613.1	690.7	0.89	0.01666
Brwd2	207425	242.2	273.0	0.89	0.02458
Tmem27	57394	6560.3	7394.1	0.89	0.00088
Morc3	338467	387.2	436.6	0.89	0.04687
Rpp30	54364	335.8	378.7	0.89	0.01396
Slc6a8	102857	2989.6	3371.7	0.89	0.02627
Spast	50850	219.3	247.4	0.89	0.00986
Zfp637	232337	507.4	572.5	0.89	0.01922
Clk4	12750	1480.5	1671.0	0.89	0.00237
Ddef2	211914	142.0	160.2	0.89	0.02028
Pnpla8	67452	1178.0	1330.0	0.89	0.01659
Trp53inp1	60599	528.8	597.6	0.88	0.01408
Auts2	319974	140.8	159.1	0.88	0.03328
Ptpn1	19246	187.3	211.8	0.88	0.03223
Banf1	23825	749.3	847.1	0.88	0.00776
Daam1	208846	155.7	176.1	0.88	0.02445
Gclm	14630	2553.5	2887.4	0.88	0.03011
Pcgf5	76073	522.6	591.2	0.88	0.03732
Sltm	66660	371.7	420.5	0.88	0.00998
Skp1a	21402	588.6	665.9	0.88	0.03428
Tinag	26944	2793.7	3161.2	0.88	0.00293
Ankrd1	107765	172.3	195.0	0.88	0.02393
Mthfs	107885	158.9	179.8	0.88	0.00193
Hist2h2ab	621893	158.0	178.8	0.88	0.00444

Psma5	26442	3217.4	3641.9	0.88	0.00110
Asah1	11886	2159.6	2444.8	0.88	0.03779
Slc11a1	18173	481.6	545.3	0.88	0.00385
Bbs7	71492	367.4	416.0	0.88	0.01683
Atad1	67979	901.5	1020.9	0.88	0.00719
Slc25a16	73132	1252.5	1418.3	0.88	0.04912
Gimap9	317758	179.5	203.4	0.88	0.03059
Mtbp	105837	159.1	180.3	0.88	0.01699
Mrpl47	74600	673.5	763.2	0.88	0.02341
Trim33	94093	356.4	403.9	0.88	0.00648
Pkia	18767	699.9	793.3	0.88	0.00790
Cml1	66116	4970.5	5634.3	0.88	0.04906
Mtmr12	268783	502.9	570.4	0.88	0.02343
Ddx21	56200	390.1	442.5	0.88	0.02515
Tdrd3	219249	634.2	719.6	0.88	0.01445
Mterfd1	66410	583.8	662.3	0.88	0.01919
Tm9sf2	68059	467.0	530.0	0.88	0.01583
Lass5	71949	845.8	960.0	0.88	0.02241
Strbp	20744	352.5	400.2	0.88	0.04171
Gcnt1	14537	5556.5	6308.3	0.88	0.01208
Pdgfc	54635	207.2	235.3	0.88	0.01865
Nat5	67877	508.4	577.6	0.88	0.03404
Fcgr2b	14130	177.1	201.2	0.88	0.02139
Agxt2l2	72947	306.8	348.6	0.88	0.02998
Hhatl	74770	324.7	368.9	0.88	0.04624
Bcl2l13	94044	444.5	505.2	0.88	0.01654
Snap23	20619	1222.0	1389.1	0.88	0.04578
Iqgap2	544963	725.9	825.5	0.88	0.01390
Kl	16591	4265.9	4855.0	0.88	0.01000
OTTMUSG00000007855	667250	289.8	329.8	0.88	0.04331
Exosc8	69639	227.0	258.4	0.88	0.00670
Abhd5	67469	578.9	659.0	0.88	0.04612
Sypl	19027	2302.3	2622.7	0.88	0.00459
Tmem176a	66058	223.6	254.8	0.88	0.03858
Crtc3	70461	202.5	230.8	0.88	0.00525
AA407659	106840	2024.4	2308.0	0.88	0.00955
Pole4	66979	203.2	231.7	0.88	0.00310
BC024659	108934	143.3	163.4	0.88	0.00451
Pdcd4	18569	1101.2	1255.9	0.88	0.02092
Zfp277	246196	553.7	631.8	0.88	0.02241

Lpgat1	226856	150.1	171.3	0.88	0.02654
2510049J12Rik	70291	268.2	306.1	0.88	0.00662
1110002B05Rik	104725	632.5	721.9	0.88	0.00020
Rap2c	72065	213.1	243.2	0.88	0.00959
Thoc7	66231	2713.9	3098.3	0.88	0.02921
Prdx2	21672	392.9	448.6	0.88	0.04489
Ndufaf1	69702	944.7	1078.7	0.88	0.00617
Tram1	72265	2181.8	2492.8	0.88	0.01165
1700029F09Rik	75623	364.4	416.5	0.88	0.01871
Usp10	22224	162.7	185.9	0.87	0.00011
Tpm4	326618	2158.5	2468.2	0.87	0.02346
Lrp12	239393	354.8	405.8	0.87	0.00546
Rev3l	19714	221.8	253.7	0.87	0.00890
Ube2u	381534	189.9	217.2	0.87	0.01163
Ccdc84	382073	302.3	345.8	0.87	0.01990
Ccdc88a	108686	135.3	154.8	0.87	0.00029
Adam9	11502	322.7	369.2	0.87	0.00350
Mesdc1	80889	134.4	153.8	0.87	0.01301
Ypel5	383295	159.7	182.8	0.87	0.03131
Psma4	26441	4684.7	5361.7	0.87	0.02691
Mrpl40	18100	857.5	981.6	0.87	0.01346
Rprd1b	70470	269.4	308.7	0.87	0.03434
Ipp	16351	250.1	286.5	0.87	0.04409
Dhx32	101437	556.5	638.0	0.87	0.02441
Jam4	72058	1063.4	1219.6	0.87	0.01036
Csda	56449	199.3	228.5	0.87	0.02096
Fnip1	216742	1012.3	1161.0	0.87	0.04552
Eef1e1	66143	333.5	382.7	0.87	0.00014
Tmem49	75909	1486.4	1706.4	0.87	0.01190
Tcfap2b	21419	757.1	869.2	0.87	0.01827
BC088983	382010	175.1	201.0	0.87	0.00921
1600021P15Rik	239796	837.8	962.7	0.87	0.01672
Ap1gbp1	217030	315.4	362.5	0.87	0.03592
Slain2	75991	587.6	675.6	0.87	0.04431
Zfp553	233887	172.5	198.3	0.87	0.02560
Mbnl2	105559	689.1	792.6	0.87	0.01962
Abcb7	11306	560.0	644.2	0.87	0.02192
Nampt	59027	313.3	360.4	0.87	0.03138
Tmtc4	70551	158.4	182.3	0.87	0.02579
Plxna2	18845	222.1	255.9	0.87	0.02473

Fhl1	14199	2778.6	3201.8	0.87	0.04176
Acsl3	74205	378.9	436.7	0.87	0.03785
Rhbdl2	230726	1280.1	1475.5	0.87	0.04667
Tmod3	50875	368.4	424.7	0.87	0.00110
Eef1b2	55949	1056.5	1218.1	0.87	0.00335
Rnf216	108086	158.4	182.6	0.87	0.03831
Zc3h15	69082	548.2	632.1	0.87	0.00732
3300001P08Rik	67684	1207.1	1392.1	0.87	0.00064
N4bp2	333789	164.4	189.7	0.87	0.02651
Sgtb	218544	136.4	157.5	0.87	0.03593
BC013529	215751	1738.9	2007.9	0.87	0.00059
Actr3	74117	1439.3	1662.7	0.87	0.01352
Atg10	66795	794.4	917.6	0.87	0.01028
Ccdc68	381175	338.7	391.2	0.87	0.02656
Cyp2j9	74519	306.3	354.0	0.87	0.02619
Syap1	67043	793.9	917.8	0.87	0.01668
Nab1	17936	219.1	253.3	0.87	0.01459
Irx2	16372	541.3	625.9	0.86	0.02161
Mcm4	17217	517.0	597.8	0.86	0.00917
Lin54	231506	418.1	483.6	0.86	0.03092
Senp7	66315	296.9	343.4	0.86	0.00875
Ube2e3	22193	139.7	161.6	0.86	0.03967
Pum2	80913	269.3	311.7	0.86	0.01229
Hrsp12	15473	6402.1	7415.9	0.86	0.01283
2810008M24Rik	75616	946.6	1096.9	0.86	0.01620
Rad23a	19358	216.1	250.5	0.86	0.02956
Ugp2	216558	517.9	600.6	0.86	0.00110
Mbnl1	56758	1939.2	2249.0	0.86	0.01412
Mrpl50	28028	2249.8	2609.8	0.86	0.00050
Letm1	56384	1042.2	1209.1	0.86	0.00043
Actr10	56444	1343.6	1559.4	0.86	0.00024
Acadsb	66885	901.0	1046.2	0.86	0.03176
9130415E20Rik	16423	1556.3	1807.9	0.86	0.01858
Upf3a	67031	323.6	376.0	0.86	0.03437
Whsc1l1	234135	232.3	269.9	0.86	0.01511
E2f5	13559	537.8	624.9	0.86	0.02933
Fbxl14	101358	757.1	879.7	0.86	0.00749
Rfwd2	26374	338.7	393.7	0.86	0.00676
Mcts1	68995	849.0	987.7	0.86	0.01327
Lum	17022	150.2	174.8	0.86	0.00429

Stat3	20848	895.1	1041.9	0.86	0.04052
Krcc1	57896	473.7	551.7	0.86	0.00194
Psma7	26444	1751.0	2040.4	0.86	0.00030
Hprt1	15452	333.2	388.4	0.86	0.00518
Sdccag1	66244	263.2	306.9	0.86	0.01174
Osbpl3	71720	640.7	748.1	0.86	0.02083
B230219D22Rik	78521	884.9	1033.4	0.86	0.01379
Hyal1	15586	201.6	235.5	0.86	0.00057
Lgals8	56048	338.9	396.0	0.86	0.00023
Wapal	218914	363.8	425.3	0.86	0.00284
Bnc2	242509	175.6	205.3	0.86	0.04839
6330409N04Rik	66674	182.7	213.6	0.86	0.00177
Smek2	104570	447.5	523.2	0.86	0.04938
Atg3	67841	460.9	539.2	0.85	0.02036
Ank3	11735	630.3	737.7	0.85	0.01631
Tbl1xr1	81004	256.1	299.8	0.85	0.02692
Alg14	66789	502.8	588.7	0.85	0.02881
Keap1	50868	303.5	355.7	0.85	0.03519
Ddo	70503	419.8	492.1	0.85	0.03911
Tipin	66131	402.2	471.7	0.85	0.04209
Hccs	15159	226.7	266.0	0.85	0.00403
Paip2	67869	435.6	511.2	0.85	0.00388
Tor1aip1	208263	454.8	533.7	0.85	0.04269
Ercc5	22592	374.4	439.4	0.85	0.00913
Rwdd1	66521	1294.1	1520.2	0.85	0.00496
Acvr1	11477	219.7	258.3	0.85	0.00036
Hebp1	15199	1357.5	1598.1	0.85	0.04007
Dmxl1	240283	388.9	458.0	0.85	0.00972
Sgpp1	81535	2061.7	2428.2	0.85	0.01759
Hexim1	192231	601.4	708.6	0.85	0.03406
Gclc	14629	159.8	188.3	0.85	0.04429
Mrpl20	66448	951.1	1121.1	0.85	0.04056
Dnajc5	13002	1385.1	1632.9	0.85	0.04118
Id2	15902	144.5	170.4	0.85	0.00708
Arhgap18	73910	622.5	734.4	0.85	0.02243
Trpc1	22063	155.9	183.9	0.85	0.03539
Etv1	14009	156.6	184.9	0.85	0.01852
Gtf2h2	23894	1098.8	1297.1	0.85	0.02444
Akr1e1	56043	507.9	600.5	0.85	0.02408
Mccc1	72039	288.3	341.0	0.85	0.01206

Cacna1d	12289	1818.3	2153.3	0.84	0.00412
Dpp7	83768	1802.5	2135.8	0.84	0.00647
Zfp592	233410	304.4	360.7	0.84	0.02200
Vps29	56433	655.7	777.0	0.84	0.00136
Stard3nl	76205	508.0	602.6	0.84	0.03293
Wisp1	22402	190.4	225.9	0.84	0.02199
Slc17a5	235504	493.4	585.7	0.84	0.02410
Cav1	12389	737.1	875.8	0.84	0.04814
4833420G17Rik	67392	232.0	275.9	0.84	0.01941
Taf1d	75316	175.0	208.4	0.84	0.00998
Rab11fip2	74998	151.8	180.8	0.84	0.00496
Zfp318	57908	479.8	571.5	0.84	0.01593
5830415L20Rik	68152	294.9	351.4	0.84	0.00930
Pfdn4	109054	889.0	1059.9	0.84	0.00528
Nfyb	18045	292.3	348.6	0.84	0.01611
Far1	67420	258.3	308.3	0.84	0.02940
Ahcyl1	229709	878.7	1048.7	0.84	0.00191
Sfrs6	67996	729.7	871.8	0.84	0.00283
Sc4mol	66234	491.0	587.0	0.84	0.02770
Dpysl3	22240	143.1	171.2	0.84	0.00766
Inpp5f	101490	673.2	805.2	0.84	0.01594
Ptprd	19266	1928.9	2307.5	0.84	0.02389
Cetn3	12626	1704.3	2039.7	0.84	0.00129
Elf1	13709	527.0	631.0	0.84	0.00913
Irak1	16179	288.0	344.9	0.83	0.00616
Riok1	71340	292.4	350.4	0.83	0.00845
Ndfip2	76273	537.9	644.6	0.83	0.01224
Trove2	20822	258.8	310.5	0.83	0.00460
Lima1	65970	447.9	537.6	0.83	0.04306
Setx	269254	281.3	337.9	0.83	0.00183
Aass	30956	359.0	431.6	0.83	0.01529
Arih1	23806	177.0	212.8	0.83	0.00104
Smug1	71726	251.4	302.5	0.83	0.04650
Zfp148	22661	412.6	496.9	0.83	0.03260
Pllp	67801	268.9	323.9	0.83	0.02348
Dync1li1	235661	225.7	272.0	0.83	0.02595
Sfrs15	224432	584.0	704.0	0.83	0.01902
2810021B07Rik	66308	237.5	286.7	0.83	0.01908
Rasa2	114713	164.4	198.5	0.83	0.04898
Ankrd56	78088	511.8	618.8	0.83	0.02242

Vps54	245944	854.3	1033.1	0.83	0.00012
Scg5	20394	366.1	442.8	0.83	0.02975
Cxcl1	14825	133.2	161.2	0.83	0.01174
Sdc2	15529	668.6	809.6	0.83	0.02140
Atp6v0a2	21871	446.6	541.1	0.83	0.01975
Nhlrc2	66866	229.0	277.7	0.82	0.00602
Esrrg	26381	805.8	977.4	0.82	0.00126
Robo1	19876	211.4	256.4	0.82	0.02305
6332401O19Rik	319832	516.1	626.4	0.82	0.04302
Hsp90aa1	15519	592.5	719.3	0.82	0.01998
Pex3	56535	498.0	605.2	0.82	0.00066
Cycs	13063	4398.5	5347.2	0.82	0.00215
Tle1	21885	441.6	536.9	0.82	0.01707
Map3k1	26401	636.9	774.6	0.82	0.02434
Zc3h18	76014	392.2	477.0	0.82	0.01401
Fut8	53618	629.0	765.1	0.82	0.00828
Il15	16168	380.8	463.4	0.82	0.03292
Wipf1	215280	204.6	249.0	0.82	0.00160
Cnot4	53621	183.6	223.5	0.82	0.00184
Rnf145	74315	794.6	968.0	0.82	0.01663
5730455P16Rik	70591	553.7	675.2	0.82	0.03712
Crtap	56693	674.0	822.1	0.82	0.01252
Gca	227960	286.6	349.8	0.82	0.01595
Arid1b	239985	1703.7	2080.8	0.82	0.00037
Ppm1l	242083	197.9	241.9	0.82	0.01992
Atm	11920	206.7	252.9	0.82	0.03691
Cox15	226139	677.7	829.2	0.82	0.00281
Pcmtd1	319263	204.1	249.9	0.82	0.03966
Rasal2	226525	261.9	321.1	0.82	0.04888
Nfkbiz	80859	307.0	376.4	0.82	0.00775
Snx7	76561	449.4	551.0	0.82	0.01315
Mcm6	17219	309.1	379.0	0.82	0.01758
Adam17	11491	183.8	225.3	0.82	0.04027
Rrp1b	72462	283.5	347.7	0.82	0.03436
Dhdh	71755	231.4	283.7	0.82	0.02829
Mff	75734	462.5	567.7	0.81	0.00054
Ankrd12	106585	295.0	362.4	0.81	0.00598
Plaa	18786	726.5	892.6	0.81	0.00764
Cyb5	109672	2066.2	2540.2	0.81	0.04171
Trps1	83925	389.0	478.5	0.81	0.03249

Abcc2	12780	980.1	1206.1	0.81	0.01590
Gsg2	14841	155.9	192.0	0.81	0.01623
Fkbp11	66120	244.6	301.2	0.81	0.00872
Tor1b	30934	296.6	365.3	0.81	0.00792
Dbt	13171	1573.9	1940.9	0.81	0.01027
Rsrc2	208606	492.1	607.0	0.81	0.00947
Pvrl3	58998	611.2	754.7	0.81	0.01187
Pdzrn3	55983	622.2	768.3	0.81	0.01927
BC011248	224823	363.5	449.4	0.81	0.00394
Tnrc6b	213988	197.0	244.0	0.81	0.02789
Ccdc59	52713	439.1	543.8	0.81	0.02768
Pdcd10	56426	474.3	587.5	0.81	0.01366
Kif3a	16568	379.7	470.8	0.81	0.02270
Prkd3	75292	314.9	390.5	0.81	0.00944
Slc44a4	70129	601.7	746.9	0.81	0.01295
2010106G01Rik	66552	287.5	357.1	0.81	0.00070
Coq5	52064	714.7	888.0	0.80	0.01717
Arsb	11881	1740.0	2165.8	0.80	0.01610
Tgs1	116940	175.7	219.2	0.80	0.04304
Ctdspl2	329506	447.2	558.2	0.80	0.00719
Ubr2	224826	139.8	174.6	0.80	0.00465
Lrp6	16974	185.2	231.3	0.80	0.00748
Tnfrsf12a	27279	383.8	479.6	0.80	0.02177
Kbtbd7	211255	263.8	329.6	0.80	0.00214
Cc2d2a	231214	364.7	456.2	0.80	0.01161
Usp40	227334	221.6	277.2	0.80	0.04778
Erlin1	226144	652.6	817.1	0.80	0.00207
Tnks	21951	152.3	190.8	0.80	0.03348
Tsc22d2	72033	537.0	673.3	0.80	0.00283
Itgb1	16412	147.6	185.2	0.80	0.00682
Osbpl6	99031	975.6	1224.8	0.80	0.00821
Pank3	211347	155.9	195.7	0.80	0.00627
Suz12	52615	1330.3	1670.9	0.80	0.02425
Arpp19	59046	602.6	758.1	0.79	0.00912
Marveld1	277010	183.1	230.5	0.79	0.03766
BC004022	80750	401.6	506.4	0.79	0.00453
Zfp106	20402	159.9	201.8	0.79	0.00551
Gnpda2	67980	369.6	466.9	0.79	0.03551
Klf6	23849	1367.1	1727.4	0.79	0.01455
Kif3b	16569	142.7	180.5	0.79	0.00059

Smchd1	74355	144.0	182.3	0.79	0.02188
Fcho2	218503	1401.4	1783.5	0.79	0.00108
Cdc2l1	12537	184.7	235.5	0.78	0.00921
Pbld	68371	884.9	1131.1	0.78	0.00133
Sucnr1	84112	305.6	392.2	0.78	0.00600
Arid4a	238247	241.4	309.9	0.78	0.02454
Sult1d1	53315	3556.0	4569.1	0.78	0.00157
Zbtb43	71834	186.2	239.6	0.78	0.01354
Rft1	328370	276.0	355.4	0.78	0.00385
Zbtb7a	16969	424.1	546.4	0.78	0.01785
Galnt1	14423	570.6	735.4	0.78	0.03418
Ift122	81896	282.5	364.3	0.78	0.00291
Pbrm1	66923	156.6	202.2	0.77	0.00585
Slc38a2	67760	499.5	646.9	0.77	0.00683
2210016L21Rik	72357	326.1	423.2	0.77	0.01731
Prdm2	110593	347.5	451.1	0.77	0.00502
Rc3h2	319817	232.8	302.3	0.77	0.03708
C1galt1c1	59048	411.9	535.4	0.77	0.00039
Twistnb	28071	192.4	250.7	0.77	0.00346
Gkap1	56278	1512.0	1970.8	0.77	0.03432
Tmem63b	224807	1288.1	1682.5	0.77	0.02977
Rnf11	29864	936.1	1223.5	0.77	0.00373
Upf1	19704	227.9	298.1	0.76	0.04295
Tfrc	22042	866.7	1139.6	0.76	0.00198
Tmem2	83921	298.5	392.6	0.76	0.00291
Dag1	13138	679.9	896.9	0.76	0.02695
Aph1a	226548	367.9	486.0	0.76	0.01193
Rsrc1	66880	219.5	291.7	0.75	0.00604
Papola	18789	407.8	542.8	0.75	0.02692
Gcc2	70297	170.9	227.5	0.75	0.03389
Cpeb3	208922	1040.4	1388.5	0.75	0.04417
Cbx5	12419	224.2	299.2	0.75	0.01482
Thoc2	331401	320.6	428.4	0.75	0.01098
Igf1	16000	211.3	282.5	0.75	0.00204
Coq10b	67876	833.8	1115.5	0.75	0.03393
Spag9	70834	135.5	181.5	0.75	0.00016
Slc35f3	210027	405.9	543.9	0.75	0.03945
Zfp91-cntf	664779	301.1	403.6	0.75	0.01182
Syn2	20965	177.4	237.8	0.75	0.00711
Mpp5	56217	332.3	445.8	0.75	0.02202

2410066E13Rik	68235	185.9	249.8	0.74	0.02615
Ganc	76051	301.9	407.9	0.74	0.00602
Zfp91	109910	430.1	583.8	0.74	0.01103
Rcor1	217864	282.9	384.1	0.74	0.02526
Lyrm2	108755	663.8	902.0	0.74	0.01552
Rpe	66646	500.7	680.4	0.74	0.04196
Map3k7ip2	68652	886.3	1209.9	0.73	0.00632
Pdlim5	56376	178.9	244.4	0.73	0.00365
Pik3r1	18708	1041.0	1425.2	0.73	0.01208
Gcap14	72972	324.4	447.0	0.73	0.00738
Cygb	114886	342.3	471.9	0.73	0.00515
Polr1a	20019	162.4	226.1	0.72	0.00204
Atp6v1a	11964	1938.3	2700.7	0.72	0.01311
Mllt3	70122	166.1	231.7	0.72	0.00885
Tmem169	271711	216.5	305.0	0.71	0.04754
Bat2d	226562	202.4	285.2	0.71	0.01960
9030612M13Rik	208292	251.0	355.3	0.71	0.00885
Hsd3b2	15493	466.7	661.7	0.71	0.00956
Peg3	18616	430.7	610.7	0.71	0.03683
2810474O19Rik	67246	334.0	474.6	0.70	0.00809
Zmiz1	328365	660.1	938.9	0.70	0.02243
D17Wsu92e	224647	191.6	273.0	0.70	0.00122
A430041B07Rik	328108	175.8	251.1	0.70	0.00603
Lsm12	268490	260.9	373.5	0.70	0.01024
Rgs5	19737	165.3	237.5	0.70	0.01857
Zc3h13	67302	160.6	230.6	0.70	0.00165
B230208H17Rik	227624	301.5	434.9	0.69	0.01846
Zeb2	24136	491.5	711.9	0.69	0.01223
Prcp	72461	1045.9	1518.1	0.69	0.00048
Tm7sf3	67623	295.0	428.9	0.69	0.03462
Pdpk1	18607	338.0	497.8	0.68	0.02523
5830417I10Rik	76022	246.0	364.0	0.68	0.00552
Veph1	72789	335.3	497.6	0.67	0.01987
Akap9	100986	184.5	276.8	0.67	0.00564
Ankrd11	77087	453.2	682.1	0.66	0.02501
Syne2	319565	181.3	274.4	0.66	0.00271
Impad1	242291	417.2	636.7	0.66	0.00246
Gnai1	14677	319.3	488.4	0.65	0.01494
Vmn2r-ps14	545700	270.9	415.7	0.65	0.00961
Zfp326	54367	198.9	305.4	0.65	0.01050

Nsd1	18193	176.6	271.4	0.65	0.00853
Ccnd2	12444	288.4	445.7	0.65	0.03514
Vps13a	271564	223.8	347.8	0.64	0.00270
Ddx24	27225	578.0	902.8	0.64	0.00792
Dhcr24	74754	698.5	1097.1	0.64	0.01115
Acsm2	233799	246.2	386.8	0.64	0.00692
Usp37	319651	223.8	354.0	0.63	0.00193
Add3	27360	288.0	459.0	0.63	0.00218
Eif4ebp2	13688	934.4	1497.5	0.62	0.03807
Smarca2	67155	158.5	256.5	0.62	0.00020
Nfatc3	18021	224.7	369.2	0.61	0.00419
Bach1	12013	381.2	629.6	0.61	0.02365
Ddx6	13209	1043.4	1739.5	0.60	0.00552
Chd4	107932	217.4	364.6	0.60	0.01164
Crebbp	12914	174.4	297.7	0.59	0.00123

Supplemental Table S2: Table showing differentially expressed genes from microarray data with GRHL2 ChIP peak in adult kidney not more than 2 kb away from gene body.

		Microarray gene expression level				**ChIP peak distance from gene**
Gene symbol	**Entrez ID**	**Control mouse kidney**	***Grhl2*** $^{CD\ -/-}$ **mouse kidney**	**Fold change (Control/Grhl2 CD -/-)**	**p-value**	**Adult kidney**
Prom2	192212	276.5	117.1	2.36	0.0336	0
Il17re	57890	326.4	157.3	2.08	0.0011	0
Spnb3	20743	551.9	339.3	1.63	0.0000	0
Rab25	53868	681.7	443.5	1.54	0.0015	0
Gstm2	14863	1532.4	1014.5	1.51	0.0000	0
Cldn4	12740	596.5	409.1	1.46	0.0001	0
Rab15	104886	292.4	203.7	1.44	0.0002	0
Ppl	19041	241.9	168.5	1.44	0.0002	0
Lamb3	16780	203.8	145.3	1.40	0.0000	0
Tmem45b	235135	1205.9	905.6	1.33	0.0066	0
Slc13a2	20500	1486.3	1146.5	1.30	0.0019	111
Tcf3	21415	727.2	563.5	1.29	0.0024	0
Efcab4a	213573	314.8	245.2	1.28	0.0082	0
Upk3b	100647	214.1	167.5	1.28	0.0032	0

Tmem66	67887	572.9	448.3	1.28	0.0158	0
Capg	12332	448.3	354.3	1.27	0.0221	0
Gyltl1b	228366	413.8	328.6	1.26	0.0013	1695
Acsl5	433256	1167.6	927.6	1.26	0.0082	0
Acaa2	52538	1295.1	1031.2	1.26	0.0026	0
Stap2	106766	192.5	153.4	1.26	0.0002	0
Elf3	13710	272.4	217.8	1.25	0.0240	101
Capn1	12333	230.6	184.6	1.25	0.0050	0
Mycbpap	104601	263.8	211.4	1.25	0.0296	1297
Mcat	223722	969.3	780.6	1.24	0.0000	0
Pecam1	18613	538.0	433.6	1.24	0.0108	0
Cd82	12521	2063.3	1669.4	1.24	0.0253	0
Fam171a2	217219	228.2	185.0	1.23	0.0030	1800
Esrrb	26380	1491.2	1212.0	1.23	0.0345	0
Tgfbr3	21814	813.8	665.4	1.22	0.0168	1264
Tjp3	27375	176.9	144.7	1.22	0.0046	0
Capn2	12334	407.1	333.9	1.22	0.0087	0
Ulk1	22241	517.2	424.3	1.22	0.0011	0
Tinagl	94242	497.4	408.8	1.22	0.0149	0
Rapgefl1	268480	169.7	139.5	1.22	0.0003	1819
Nedd4l	83814	1226.4	1010.8	1.21	0.0210	0
Pwwp2b	101631	159.6	131.7	1.21	0.0048	0
Scnn1a	20276	1445.1	1193.5	1.21	0.0248	0
4631426J05Rik	77590	561.2	463.6	1.21	0.0034	0
1500034J01Rik	66498	219.9	181.9	1.21	0.0319	1513
Crip2	68337	2049.9	1699.5	1.21	0.0125	806
Itfg3	106581	1173.5	975.0	1.20	0.0069	0
Slc44a2	68682	701.0	582.6	1.20	0.0228	0
BC039210	234839	584.8	486.3	1.20	0.0336	0
Mgll	23945	383.7	320.2	1.20	0.0050	0
Hdac5	15184	966.6	807.2	1.20	0.0029	0
Scnn1b	20277	1283.0	1071.4	1.20	0.0075	0
Tiam1	21844	280.6	234.4	1.20	0.0021	0
Inpp5a	212111	525.9	439.4	1.20	0.0007	0
Ptpru	19273	224.9	188.1	1.20	0.0094	0
Hdac7	56233	380.6	318.6	1.19	0.0476	0
Sort1	20661	1508.7	1263.1	1.19	0.0074	0
Capn5	12337	340.8	285.5	1.19	0.0472	0
Bik	12124	304.5	255.4	1.19	0.0049	0
Plekhg3	263406	3407.4	2858.5	1.19	0.0260	0

Prodh	19125	1758.8	1476.1	1.19	0.0047	0
Anxa6	11749	1312.8	1104.7	1.19	0.0009	0
Myh10	77579	418.2	353.0	1.18	0.0057	0
Itgb4	192897	253.2	213.8	1.18	0.0247	0
Atp8b1	54670	268.1	226.5	1.18	0.0024	0
Hk1	15275	307.5	259.9	1.18	0.0420	0
Plxnb2	140570	1569.8	1328.4	1.18	0.0158	0
Endod1	71946	850.0	720.2	1.18	0.0052	0
Unc45a	101869	390.8	331.2	1.18	0.0178	0
Lrpprc	72416	514.4	435.9	1.18	0.0197	178
1810008A18Rik	108707	357.3	303.1	1.18	0.0290	1389
Rhbdf1	13650	1260.8	1070.0	1.18	0.0066	0
Pea15a	18611	162.1	137.7	1.18	0.0093	0
Spnb2	20742	612.6	520.5	1.18	0.0432	0
Dlg3	53310	481.7	409.9	1.18	0.0088	0
Naca	17938	832.1	708.2	1.17	0.0016	1672
1110012J17Rik	68617	259.6	221.3	1.17	0.0251	0
Ppp1r9b	217124	399.9	341.5	1.17	0.0009	701
Shroom3	27428	226.3	193.3	1.17	0.0265	0
2310037I24Rik	69612	216.4	184.9	1.17	0.0076	86
Cdc42ep5	58804	304.5	260.8	1.17	0.0040	0
Smtnl2	276829	432.7	370.8	1.17	0.0213	0
Igf2r	16004	698.9	599.3	1.17	0.0097	0
Rhpn2	52428	255.8	219.4	1.17	0.0327	0
Myo5c	208943	250.5	214.9	1.17	0.0139	0
Pak6	214230	150.4	129.2	1.16	0.0023	0
Arhgef18	102098	1237.3	1063.7	1.16	0.0211	0
Cgnl1	68178	284.9	245.5	1.16	0.0000	0
Wnt7b	22422	152.9	132.0	1.16	0.0187	0
Fam102a	98952	1644.4	1420.3	1.16	0.0229	0
Cab39l	69008	906.1	784.2	1.16	0.0001	0
Rtn1	104001	209.1	181.4	1.15	0.0075	0
Fus	233908	184.3	159.9	1.15	0.0147	0
Recql5	170472	165.5	143.6	1.15	0.0022	0
Rarg	19411	160.2	139.1	1.15	0.0214	1307
Fam110a	73847	288.9	251.1	1.15	0.0007	0
Dnm1l	74006	858.1	747.1	1.15	0.0059	0
Fbxl11	225876	1605.5	1397.7	1.15	0.0296	0
Fpgs	14287	286.8	249.7	1.15	0.0489	0
Chchd8	68185	382.5	333.1	1.15	0.0081	0

Spint2	20733	176.1	153.4	1.15	0.0038	0
Tln2	70549	616.9	538.0	1.15	0.0393	0
Epb4.1	269587	297.4	259.4	1.15	0.0499	0
Mon1a	72825	342.4	298.9	1.15	0.0311	0
2310033K02Rik	69553	203.6	177.8	1.15	0.0474	0
Ccdc130	67736	426.7	372.7	1.14	0.0001	210
Lrrk1	233328	363.1	317.4	1.14	0.0026	0
Capzb	12345	701.5	613.6	1.14	0.0310	0
AW146242	232023	214.3	187.5	1.14	0.0139	0
Ubl7	69459	1162.8	1020.7	1.14	0.0090	0
Mal	17153	1024.3	901.2	1.14	0.0007	0
Ihpk1	27399	1377.4	1212.6	1.14	0.0285	0
BC029214	227622	247.3	217.9	1.14	0.0261	0
Ccdc120	54648	273.7	241.2	1.13	0.0314	0
Golt1a	68338	346.5	305.7	1.13	0.0287	34
Rufy1	216724	500.6	442.3	1.13	0.0352	0
Timp2	21858	1395.6	1236.2	1.13	0.0425	0
Nucb1	18220	1686.8	1495.4	1.13	0.0426	0
Ptbp1	19205	1731.2	1535.2	1.13	0.0062	0
Ppm1f	68606	691.8	614.0	1.13	0.0467	285
Btg1	12226	2591.1	2300.4	1.13	0.0432	0
Mrpl9	78523	846.9	752.7	1.13	0.0113	0
Ankrd40	71452	256.0	227.6	1.12	0.0214	63
Ccnd3	12445	170.5	151.7	1.12	0.0168	0
Evc2	68525	733.2	653.1	1.12	0.0087	0
Hemk1	69536	406.3	362.3	1.12	0.0478	0
Rnf4	19822	207.7	185.2	1.12	0.0444	0
Fam129b	227737	814.7	726.7	1.12	0.0295	0
Prkch	18755	174.1	155.4	1.12	0.0225	0
D15Wsu169e	223666	234.1	209.3	1.12	0.0334	0
Zw10	26951	283.9	254.4	1.12	0.0239	0
Stard10	56018	4069.0	3646.6	1.12	0.0387	0
Acot2	171210	213.5	191.5	1.11	0.0034	0
Fam100b	319370	199.0	178.6	1.11	0.0012	269
Acot8	170789	1130.7	1015.8	1.11	0.0382	523
Ppap2c	50784	2414.3	2169.9	1.11	0.0168	0
Fars2	69955	1748.9	1572.3	1.11	0.0498	0
Pcdh1	75599	389.1	350.1	1.11	0.0500	0
Ermp1	226090	1140.0	1025.6	1.11	0.0032	0
Sox13	20668	310.0	279.1	1.11	0.0398	0

Ovol2	107586	155.9	140.7	1.11	0.0117	717
Plekhg6	213522	143.7	129.8	1.11	0.0018	0
Hps4	192232	192.4	173.9	1.11	0.0243	0
Cep110	26920	165.8	149.9	1.11	0.0074	0
Slc44a1	100434	269.7	243.9	1.11	0.0134	0
Ccdc62	208908	151.9	137.6	1.10	0.0033	0
Fis1	66437	1970.2	1785.2	1.10	0.0288	0
Gpr107	277463	467.7	424.1	1.10	0.0192	0
9430015G10Rik	230996	155.9	141.4	1.10	0.0323	1183
Rassf7	66985	481.8	437.3	1.10	0.0010	0
Lcmt1	30949	175.0	159.2	1.10	0.0243	0
Pitx2	18741	183.6	167.2	1.10	0.0360	0
Dedd	21945	164.9	150.2	1.10	0.0434	112
Dyrk2	69181	152.2	139.0	1.09	0.0214	0
Map3k7ip1	66513	156.2	143.0	1.09	0.0028	0
Zfyve26	211978	433.0	396.5	1.09	0.0424	0
Mbtps1	56453	340.7	312.5	1.09	0.0490	0
Ndor1	78797	230.9	211.9	1.09	0.0247	0
Mfng	17305	161.4	148.2	1.09	0.0422	0
Tarsl2	272396	168.2	154.6	1.09	0.0113	800
Foxk1	17425	148.0	136.2	1.09	0.0361	0
Ick	56542	186.9	172.0	1.09	0.0172	0
1190007F08Rik	68859	1668.0	1537.9	1.08	0.0307	0
Tm2d3	68634	234.4	216.6	1.08	0.0239	289
Numb	18222	142.2	131.7	1.08	0.0424	0
Stard3	59045	224.4	209.1	1.07	0.0410	0
Mnat1	17420	327.8	306.0	1.07	0.0351	0
Kif16b	16558	142.6	133.2	1.07	0.0174	0
D030016E14Rik	320714	171.5	160.4	1.07	0.0229	0
Grhl2	252973	191.2	180.1	1.06	0.0306	0
Mdfic	16543	141.0	132.9	1.06	0.0278	445
Atp2c1	235574	166.8	157.4	1.06	0.0211	0
Exoc4	20336	396.8	374.8	1.06	0.0318	0
Lrrfip1	16978	146.5	138.7	1.06	0.0183	0
Ccdc41	77048	301.0	315.0	0.96	0.0358	0
2610101N10Rik	67958	1112.0	1177.8	0.94	0.0291	757
Atp6v1b1	110935	130.5	139.1	0.94	0.0248	0
Kifc3	16582	193.5	206.6	0.94	0.0283	0
Ywhab	54401	2898.9	3102.6	0.93	0.0488	0
Smo	319757	506.3	543.3	0.93	0.0130	0

Farsb	23874	1046.2	1123.0	0.93	0.0411	0
Sfrs3	20383	275.7	296.4	0.93	0.0459	913
March7	57438	170.5	183.7	0.93	0.0495	0
Serf2	378702	2945.2	3176.6	0.93	0.0342	130
Pde4dip	83679	1103.3	1194.3	0.92	0.0492	0
Ehbp1	216565	138.4	150.0	0.92	0.0170	0
Gchfr	320415	698.6	758.7	0.92	0.0150	437
Pbx1	18514	273.1	296.6	0.92	0.0111	0
Nat12	70646	489.6	532.7	0.92	0.0302	133
Galnt14	71685	143.0	155.6	0.92	0.0411	0
Lamp2	16784	5190.2	5659.4	0.92	0.0055	0
Sae1	56459	313.7	343.1	0.91	0.0286	0
5830404H04Rik	207781	323.8	354.6	0.91	0.0256	0
Ryk	20187	1163.9	1275.0	0.91	0.0016	0
Cd164	53599	5292.2	5809.0	0.91	0.0222	770
Pkp2	67451	562.3	618.1	0.91	0.0007	0
Tpp2	22019	200.2	220.6	0.91	0.0402	0
Tmem135	72759	199.3	219.6	0.91	0.0312	0
Hnf4a	15378	2824.6	3116.5	0.91	0.0249	0
Tmem35	67564	172.6	190.5	0.91	0.0305	0
Zfand6	65098	163.6	180.6	0.91	0.0081	0
Srp19	66384	145.0	160.1	0.91	0.0256	1622
Asb13	142688	1914.7	2117.2	0.90	0.0111	0
Cnot2	72068	634.9	704.1	0.90	0.0413	0
C730025P13Rik	227615	251.9	279.5	0.90	0.0457	10
Tmem68	72098	704.6	782.5	0.90	0.0329	0
Nqo2	18105	366.8	407.9	0.90	0.0073	0
Adk	11534	3627.4	4036.0	0.90	0.0043	0
Acin1	56215	188.2	209.5	0.90	0.0036	0
Slit2	20563	580.8	646.5	0.90	0.0437	0
Iqwd1	74106	420.6	468.2	0.90	0.0348	0
Tor1aip2	240832	214.6	238.9	0.90	0.0131	0
Ints12	71793	237.5	265.3	0.90	0.0356	0
Rars2	109093	565.4	635.6	0.89	0.0045	37
4921505C17Rik	78757	514.6	578.6	0.89	0.0228	0
Fbxo9	71538	825.9	929.6	0.89	0.0031	0
Sepsecs	211006	160.3	180.4	0.89	0.0199	0
Wwtr1	97064	857.8	966.2	0.89	0.0065	0
Brwd2	207425	242.2	273.0	0.89	0.0246	0
Ddef2	211914	142.0	160.2	0.89	0.0203	0

Pnpla8	67452	1178.0	1330.0	0.89	0.0166	0
Daam1	208846	155.7	176.1	0.88	0.0244	0
Skp1a	21402	588.6	665.9	0.88	0.0343	246
Pkia	18767	699.9	793.3	0.88	0.0079	0
Lass5	71949	845.8	960.0	0.88	0.0224	0
Pdgfc	54635	207.2	235.3	0.88	0.0187	0
Iqgap2	544963	725.9	825.5	0.88	0.0139	0
Sypl	19027	2302.3	2622.7	0.88	0.0046	0
Zfp277	246196	553.7	631.8	0.88	0.0224	0
Lpgat1	226856	150.1	171.3	0.88	0.0265	0
Tram1	72265	2181.8	2492.8	0.88	0.0117	0
Usp10	22224	162.7	185.9	0.87	0.0001	0
Jam4	72058	1063.4	1219.6	0.87	0.0104	246
Tmem49	75909	1486.4	1706.4	0.87	0.0119	0
Tcfap2b	21419	757.1	869.2	0.87	0.0183	0
1600021P15Rik	239796	837.8	962.7	0.87	0.0167	0
Mbnl2	105559	689.1	792.6	0.87	0.0196	0
Plxna2	18845	222.1	255.9	0.87	0.0247	0
Acsl3	74205	378.9	436.7	0.87	0.0379	1218
Rhbdl2	230726	1280.1	1475.5	0.87	0.0467	0
Tmod3	50875	368.4	424.7	0.87	0.0011	0
Ccdc68	381175	338.7	391.2	0.87	0.0266	0
Nab1	17936	219.1	253.3	0.87	0.0146	0
Senp7	66315	296.9	343.4	0.86	0.0088	1784
9130415E20Rik	16423	1556.3	1807.9	0.86	0.0186	0
Whsc1l1	234135	232.3	269.9	0.86	0.0151	0
Stat3	20848	895.1	1041.9	0.86	0.0405	0
Osbpl3	71720	640.7	748.1	0.86	0.0208	0
Ank3	11735	630.3	737.7	0.85	0.0163	0
Tbl1xr1	81004	256.1	299.8	0.85	0.0269	150
Ddo	70503	419.8	492.1	0.85	0.0391	0
Tor1aip1	208263	454.8	533.7	0.85	0.0427	1691
Rwdd1	66521	1294.1	1520.2	0.85	0.0050	0
Etv1	14009	156.6	184.9	0.85	0.0185	0
Cacna1d	12289	1818.3	2153.3	0.84	0.0041	0
4833420G17Rik	67392	232.0	275.9	0.84	0.0194	0
Elf1	13709	527.0	631.0	0.84	0.0091	0
Riok1	71340	292.4	350.4	0.83	0.0085	1434
Lima1	65970	447.9	537.6	0.83	0.0431	0
Setx	269254	281.3	337.9	0.83	0.0018	0

Pllp	67801	268.9	323.9	0.83	0.0235	0
Dync1li1	235661	225.7	272.0	0.83	0.0259	124
2810021B07Rik	66308	237.5	286.7	0.83	0.0191	0
Esrrg	26381	805.8	977.4	0.82	0.0013	0
Map3k1	26401	636.9	774.6	0.82	0.0243	0
Il15	16168	380.8	463.4	0.82	0.0329	381
Cnot4	53621	183.6	223.5	0.82	0.0018	48
5730455P16Rik	70591	553.7	675.2	0.82	0.0371	29
Arid1b	239985	1703.7	2080.8	0.82	0.0004	0
Ppm1l	242083	197.9	241.9	0.82	0.0199	0
Rasal2	226525	261.9	321.1	0.82	0.0489	0
Nfkbiz	80859	307.0	376.4	0.82	0.0078	0
Dbt	13171	1573.9	1940.9	0.81	0.0103	824
Pdzrn3	55983	622.2	768.3	0.81	0.0193	0
Arsb	11881	1740.0	2165.8	0.80	0.0161	0
Tgs1	116940	175.7	219.2	0.80	0.0430	88
Ubr2	224826	139.8	174.6	0.80	0.0046	0
Lrp6	16974	185.2	231.3	0.80	0.0075	0
Osbpl6	99031	975.6	1224.8	0.80	0.0082	0
Suz12	52615	1330.3	1670.9	0.80	0.0243	264
Klf6	23849	1367.1	1727.4	0.79	0.0146	0
Arid4a	238247	241.4	309.9	0.78	0.0245	293
Zbtb7a	16969	424.1	546.4	0.78	0.0179	0
Pbrm1	66923	156.6	202.2	0.77	0.0059	0
Dag1	13138	679.9	896.9	0.76	0.0269	0
Cpeb3	208922	1040.4	1388.5	0.75	0.0442	0
Mpp5	56217	332.3	445.8	0.75	0.0220	1193
2410066E13Rik	68235	185.9	249.8	0.74	0.0261	0
Pdlim5	56376	178.9	244.4	0.73	0.0036	0
Pik3r1	18708	1041.0	1425.2	0.73	0.0121	0
Zmiz1	328365	660.1	938.9	0.70	0.0224	0
B230208H17Rik	227624	301.5	434.9	0.69	0.0185	0
5830417I10Rik	76022	246.0	364.0	0.68	0.0055	0
Akap9	100986	184.5	276.8	0.67	0.0056	0
Syne2	319565	181.3	274.4	0.66	0.0027	0
Nsd1	18193	176.6	271.4	0.65	0.0085	0
Smarca2	67155	158.5	256.5	0.62	0.0002	0

Supplemental Table S2: *Grhl2*-deficient mice have normal acid-base homeostasis.

To exclude an acid-base imbalance blood gas analysis was performed using iStat (Abbott) as described in the methods section. The following parameters were determined in whole blood samples of P30 mice (n=4 biological replicates): blood pH, pCO_2 – partial pressure of CO_2, pO_2 - partial pressure of O_2, BE (ecf) – base excess (extracellular fluid), HCO_3 – hydrogen carbonate, TCO_2 – total amount of CO_2, SO_2 – oxygen saturation, Na – sodium, K –potassium, iCa – ionized calcium, Glu – glucose, Hct – hematocrit, Hb – hemoglobin. Statistical *P*-values ≥ 0.05, not significantly different vs. controls.

Blood gas analysis		***Control***		***Grhl2*** $^{CD\ -/-}$		
Parameter	**Unit**	**Average**	**SD**	**Average**	**SD**	**TTEST**
pH		7.33	0.04	7.32	0.04	0.74
pCO_2	mmHg	44.95	3.49	47.68	3.82	0.33
pO_2	mmHg	59.00	7.62	51.50	12.77	0.35
BE (ecf)	mmol/l	-1.75	2.63	-1.25	1.26	0.74
HCO_3	mmol/l	23.98	2.04	24.78	0.46	0.47
TCO_2	mmol/l	25.00	2.16	26.25	0.50	0.30
SO_2	%	87.75	5.91	80.75	7.68	0.20

Supplemental Table S3: qPCR primer list.

Gene symbol	Forward primer sequence (5'→3')	Reverse primer sequence (5'→3')
Aqp4	ACGGTTCATGGAAACCTCAC	ATGATAACTGCGGGTCCAAA
Tjp3	ATTGAGAAGTCGGAGGGGGA	CAGGAGACTCTGGTTCAGCG
Shroom3	AGCGAACTGCGAACCGAG	CACATCCTGACCTTTCTTGTCGG
Myh10	ATGGCAGAGCTGACATGCTT	CCGATTCACCCGTGCATAGAA
Prkch	CCGAGAGTTCATCTGGGGAGTA	GGATGTTGATGCCAAACCGC
Igsf5	TCCAGGAGAGAAAAGGAAGAATCTA	CCTCATCCGAACTGTACCCG
Epb4.1	AAGCAGGTTCGAGGTGTTCC	GTTGCAAAGGAACAGGGCAG
Sptbn1	GACATCAACAAGGCCTGGGA	TGTCTCCCTCATAGCTGCCT
Cldn10	GAGGACTAATGATCGCTGCGG	GTCATGGAACACAGACCTGACAAT
Cldn11	ACATCCTCATCCTTCCAGGCTA	GCAGAATAAGGAGCACCCCA
Cldn15	TCCACATACTTGCTGGAGCC	CCTCCTTGGAGGAACAGCAG
Cldn19	CGAAGGGCTGTGGATGTCTT	ACAGAGACCTGCCAAGAGGA

Supplemental Methods

Antibodies

The following antibodies were used: anti-acetylated α-tubulin (clone 6-11B-1, T6793, Sigma-Aldrich, Hamburg, Germany), anti-AQP2 (C-17, sc-9882, Santa Cruz Biotechnology, Dallas, Texas), anti-AQP3 (C-18, sc-9885, Santa Cruz Biotechnology, Dallas, Texas), anti-AQP4 (H-80, sc-20812, Santa Cruz Biotechnology), anti-β-catenin (610154, BD Biosciences, Heidelberg, Germany), anti-collagen IV (AB756, Millipore, Billerica, MA), anti-cytokeratin 8 (TROMA-I, Developmental Studies Hybridoma Bank, DSHB; developed by Philippe Brulet and Rolf Kemler under the auspices of the NICHD and maintained by the University of Iowa, Department of Biology, Iowa City), anti-GRHL2 (HPA004820, Sigma-Aldrich), anti-ITGB1 (clone MB1.2, MAB1997, Millipore), anti-SLC4A1 (AE11-A, Alpha Diagnostics, San Antonio, Texas), anti-SLC26A4 (Pendrin) (sc-50346, Santa Cruz Biotechnology), anti-TJP1 (412200, Life Technologies, Darmstadt, Germany) and anti-V-ATPase (sc-20943, Santa Cruz Biotechnology).

For western blot analysis of UT-A1 and UT-A3 expression we used an antibody targeting the N-terminus of both proteins.[6]

Collecting duct lumen area analysis (2D)

Immunohistochemical staining was performed on 4 µm thick dewaxed and rehydrated paraffin sections. Applying peroxidase-based EnVisionTM-Kit (K4008, DakoCytomation) according to the manufacturer's instructions sections were stained for AQP2. Images of the outermost part of the inner medulla were gathered with an inverted Leica microscope DMI 6000B (Leica Biosystems, Nussloch, Germany). ImageJ 1.46r was used for collecting duct lumen area analysis [7]. Pictures were transformed into binary 8bit files and processed with the command "find edges" to label inner and outer edges of collecting duct cross sections. Wand tool was used to select and measure collecting duct lumen area.

Collecting duct microdissection

Kidneys of sacrificed mice were perfused with 0.6 - 1 ml of incubation solution containing 1 mg/ml collagenase type II at 37°C and kidneys were harvested. Kidneys were then decapsulated and cut into 0.2 to 0.3-mm thick slices (preferably parallel to the course of the nephrons). Slices were transferred into 1ml of the same enzyme-containing incubation solution (2mg/ml) and incubated for 10 minutes at 37°C in 2ml Eppendorf tubes and kept on a thermomixer at 850rpm. Afterwards, the supernatant is tranferrred into a new Eppendorf tube (released tubules) on ice which contains 1ml ice-cold sorting solution (plasma-adapted full electrolyte solution with glucose, alpha-ketoglutarate, glycin and albumin, pH 7.4).

Remaining tissue is again incubated with incubation solution on the thermomixer. This cycle is repeated 5-6 times. Tubule suspension was then gently pipetted into a dissection dish (35mmØ) containing 3ml incubation solution and tubules were selected at 4°C under a stereo microscope (Leica M165 C with Rottermann contrast-transmitted light base). Collecting ducts were selected by using fine forceps and directly transferred into RLT buffer. Tubule sorting was finished within 2 hours (Forceps: Dumont 5, with acute tips and sharpened cutting edges).

CRISPR/Cas9-mediated GRHL2 knockout in IMCD3 cells

Mouse inner medullary collecting duct cells (mIMCD3) (ATCC, CRL-2123) with a knockout of Grhl2 are described in detail elsewhere (Ming et al., submitted). Briefly, a knockout of *GRHL2* was induced by CRISPR-Cas9 technology. Two oligonucleotides designed to yield sgRNAs targeting exon 2 of the *GRHL2* gene (5'- CACCG TCGCC TTGGT GGCCG CAGTC-3'; 5'-AAACG ACTGC GGCCA CCAAG GCGAC-3') were annealed and cloned into BbsI-digested pX330-Cas9-T2A-mCherry plasmid (Addgene, Place). mIMCD3 cells were transiently transfected using Lipofectamine® 3000 transfection reagent (Thermo Fisher Scientific, Waltham, MA, USA). After 48 h, mCherry-positive cells were selected by fluorescence activated cell sorting and replated for culturing. Single-clonally derived colonies were picked and analyzed for mutations at the target region of *GRHL2* exon 2. Three clones (designated clones 21b, 24b und 26c) were found to carry frame shift-inducing exon 2 mutations resulting in homozygous inactivation of *GRHL2*.

EM and EM tight junction depths measurements

Ultrathin sections from glutaraldehyde-fixed, Epon-embedded samples from control (n=3) and transgenic animals (n=2) were evaluated. At least 10 tubular profiles were randomly chosen per individual, and all tight junctions within these profiles were included to measure apico-basal depth. Only perpendicularly sectioned tight junctions were selected and their apical-basal extension measured between their luminal onset and their transition to the adherens junctions. Values from tight junctions between principal cells or between principal cells and intercalated cells were pooled. Measurements were performed in ImageJ format from pictures taken at x27.000 primary magnification with a Tecnai Twin G20 transmission electron microscope (FEI).

Imaris 3D analysis

Z-stacks of triple-immunofluorescently stained P30 kidney sections (principal cell-specific AQP2, phalloidin labeling F-actin accumulated along cellular membranes, TJP1 staining tight junctions) were analyzed for tubular and lumen volume of inner medullary collecting ducts as well as single cell volume of principal cells and intercalated cells using Imaris software

package (version 8.3.1, Bitplane, Zurich, Switzerland). For tubular and lumen volume five 15 µm collecting duct segments were analyzed (50 pictures, interval 0.3 µm). In an effort to reconstruct collecting duct volume inner and outer borders of the selected tubules were manually drawn (drawing settings: vertex spacing 0.5µm, shape max. accurate, impact max. strong). Subsequently a surface was created (based on the 50 drawings) representing a 3D object of tubular or lumen volume. To determine cell density of the reconstructed 15 µm collecting duct segment, cells within the surface were counted. Incompletely recorded cells located at the edge of the selected 15 µm collecting duct segment were counted as half cells if their nucleus was at least partially visible.

Additionally single cell volumes of principal cells and intercalated cells were reconstructed. For that purpose five representative cells were selected and their outer border was manually drawn. Again a surface was created representing single cell volume. Using these 3D-objects representing reconstructions of total cellular surface with TJP1-staining, apical membrane surface was reconstructed and thus apical membrane area was determined.

Using the as above described ascertained volumes we were able to calculate single cell volume: $(V_{Tubule}-V_{lumen})/(n_{PC}+f_{IC/PC}*n_{IC})$ with tubule volume (V_{Tubule}), lumen volume (V_{lumen}), number of principal cells (n_{PC}), number of intercalated cells (n_{IC}) and size factor $f_{IC/principal\ cell}$ (describing the ratio of intercalated cell and principal cell single cell volume). The factor $f_{IC/PC}$ was determined by measurements of single cell volumes (as described above) and differs between control and *Grhl2* $^{CD\ -/-}$ mice ($f_{IC/PC}$ control = 1.026; $f_{IC/PC}$ *Grhl2* $^{CD\ -/-}$ = 1.316).

Immunofluorescence staining and microscopy

Kidneys of adult mice (P30) were cut into slices and fixed in PBS/4% paraformaldehyde for 1 hour at 4°C and embedded in Tissue-Tek® O.C.T.™ Compound (Sakura Finetek) for cryo-sectioning. Cryo-embedded kidneys were cut into 16 µm thick sections and subjected to immunofluorescent staining. After incubation of tissue sections in blocking buffer (PBS/1% BSA/0.1% triton-X-100) for 1 h, primary antibodies were incubated overnight at 4°C. Primary antibodies were detected with secondary antibodies diluted in blocking buffer and labeled by Cy2, Cy3, Cy5, Alexa488 or Alexa647 (Jackson ImmunoResearch, Newmarket, UK). Nuclei were visualized using TO-PRO®-3 iodide or SYTOX® Green (Life Technologies). Tissue was mounted with Dako Fluorescent Mounting Medium (Agilent Technologies). GRHL2 immunostaining required antigen retrieval which was done by incubation of slides for 20 min at 100°C in 10 mM citrate buffer pH 6.0.

Fluorescent microscopy was done on an inverted Zeiss LSM700 (Carl Zeiss Microscopy, Jena, Germany) or TCS SP5 Tandem confocal microscope (Leica Microsystems GmbH, Wetzlar, Germany). For comparing relative intensity of immunofluorescent staining, the z-

plane was adjusted for maximal fluorescence intensity, and image acquisition settings were maintained to be identical for all samples.

For 3D-reconstruction of medullary collecting ducts P30 kidneys were cut in slices, fixed in PBS/ 4% paraformaldehyde for 30 min at 4°C and blocked for 30 min in 50 mM NH_4Cl at room temperature (RT). Subsequently kidney slices were embedded in PBS/ 6% agarose (UltraPure LMP Agarose, low melting point, ThermoFisher Scientific, Hennigsdorf, Germany) and cut into 100 µm sections using a vibratome (VT1200S, Leica Biosystems, Nussloch, Germany). Permeabilization in PBS/ 1% bovine serum albumin/ 0.25% Triton X-100 and primary antibody (for 3D-reconstruction: anti-AQP2, phalloidin (A34055, Life Technologies), anti-TJP1) incubation was performed at 4°C overnight as floating sections in 24-well plates. After secondary antibody incubation (4 h, RT, floating sections) sections were placed on object slides, covered with Dako Fluorescent mounting medium and cover slip, and sealed with nail polish. Stacks of confocal images (z-stack) were obtained with an inverted Zeiss LSM 700 at an interval of 0.3 µm and subsequently analysed using Imaris software package.

Immunohistochemistry

Immunohistochemistry was performed using the EnVision System-HRP (AEC) kit for goat primary antibodies (DakoCytomation, Hamburg, Germany) according to manufacturer's instructions. Tissues were fixed in PBS/4% paraformaldehyde for 1 h at 4°C, dehydrated and embedded in paraffin and cut into 10 µm thick sections.

Masson trichrome staining

Paraffin-embedded tissue was cut into 4 µm thick sections. Before staining, slides were incubated for 30 min to 2 h at 62°C lying upright in a rack to melt off the paraffin wax. After drying for 30 min at RT tissue sections were dewaxed by incubating two times in toluol for 5 min and rehydrated using a descending ethanol series (100% ethanol: 2 x 2 min, 96% ethanol: 2 x 2 min, 80% ethanol: 1 x 2 min, 70% ethanol: 1 x 2 min, ddH_2O: 1 x 2 min). Masson trichrome staining was performed using Trichrome Stain (Masson) Kit (HT15, Sigma-Aldrich), Weigert's Iron haematoxylin solution A and B as well as acetic acid. Dewaxed and rehydrated slides were stained in Weigert's Iron haematoxylin solution (solution A and B mixed 1:1) for 4 min. After 5 min washing in running tap water and rinsing in ddH_2O slides were incubated in Biebrich Scarlet-Acid Fuchsin (0.18% Biebrich scarlet, 0.02% acid fuchsin in 1.0% acetic acid). Slides were rinsed in ddH_2O three times and subsequently bathed in Phosphotungstic/Phosphomolybdic Acid Solution (2.5% Phosphotungstic Acid, 2.5% Phosphomolybdic Acid in ddH_2O) for 5 min. Afterwards slides were immediately placed into Aniline Blue Solution (0.24% Aniline Blue in 0.2% acetic acid) for 50 s followed by 2 min in acetic acid, 1%. Finally, slides were dehydrated using a short ascending ethanol series (90%

ethanol: 1 x 1 min, 99% ethanol: 2 x 1 min), afterwards slides were incubated in Xylol (2 x 3 min) and embedded using Eukitt (Sigma-Aldrich). Subsequent analysis of masson trichrome-stained slides was achieved using an inverted Leica microscope DMI 6000B (Leica Biosystems).

Measurements of paracellular flux and TER in IMCD3 cells

After reaching confluency (confirmed by immunofluorescence and saturation of TER), IMCD3 cells were exposed to apicobasal gradients of sodium chloride and urea. Urea concentration in the basal medium was 100mmol/l and 10mmol/l in the apical medium. For sodium, basal concentration was 260 and apical 160mmol/l. Chloride basal concentration was 220 and apical 120mmol/l. To prevent transcellular sodium passge, 10µM amiloride was added. Absence of UT-A1 and 3 expression was confirmed by immunofluorescence (not shown).

Microarrays

Total RNA from adult kidneys was isolated using the RNeasy Mini Kit (Qiagen, Hilden, Germany) according to manufacturer's instructions including treatment with RNase-free DNase I (Qiagen). Subsequently, RNA was amplified for hybridization with Illumina® Sentrix arrays using the Ambion® Illumina® TotalPrep™ RNA Amplification Kit (Life Technologies). The quality of RNA and cRNA was evaluated using Agilent 2100 Bioanalyzer and the Agilent RNA 6000 Nano kit (Agilent Technologies). Differential genome-wide gene expression was examined by Illumina® Mouse WG-6 v2.0 Expression Bead Chip microarray analysis.

Microarray data analysis and visualization

After quantile normalization of the data, we considered genes as differentially expressed if the p-value according to Student's t-test was less than 0.05 for one probe on the Illumina® microarray chip. Heatmap visualization was done using self-written scripts using the matplotlib package for Python. Heatmap visualized data has been maximum normalized on a per-gene basis.

Primary medullary CD (pmCD) cell culture

Medullary CD (MCD) cells were isolated from the medullae of *Grhl2*$^{+/+}$ and *Hoxb7;Grhl2*$^{flox/-}$ mice and seeded on round cover slips placed in cell culture dishes as described previously[2]. MCD cells were grown for 3 days in high glucose/osmolarity DMEM medium (4.5 g/L/ 600 mosmol (100 mM NaCl and 100 mM urea)) supplemented with 1% non-essential amino acids, 1% ultroser, 500 µM DBcAMP, 20 U/ml nystatin and 0.25 µg/ml gentamicin. Before stimulation with AVP cells were incubated for 24 hours in the above mentioned medium without DBcAMP and nystatin. Subsequently, primary MCD cells were left either under control conditions (medium without AVP) or were stimulated with medium containing 100 nM

AVP for 30 min at 37°C. For IF, MCD cells were fixed with 2.5% paraformaldehyde (PFA) in PBS, then incubated in 50 mM NH_4OAc for PFA quenching and subjected to immunofluorescent staining. After incubation of the cells in blocking buffer (PBS/1% BSA/0.05% triton-X-100) for 1 hour, the primary Aqp2 antibody (1:100; C-17, sc-9882; Santa Cruz, Heidelberg, Germany) was incubated overnight at 4°C in blocking solution. The primary antibody was detected with a secondary antibody diluted in blocking buffer and labeled by Cy2 (Jackson ImmunoResearch, Newmarket, UK). Nuclei were visualized with TO-PRO-3 iodide (Life Technologies GmbH, Darmstadt, Germany). Fluorescent microscopy was done on an inverted TCS SP5 Tandem confocal microscope (Leica Microsystems GmbH, Wetzlar, Germany).

AQP2 immunofluorescence (IF) quantification in pmCD cells

20 AQP2-positive cells were randomly selected per experiment for control and Grhl2 CD-/- mice. We quantified AQP2 abundance in the direction and section of maximum AQP2 IF intensity per cell from the nucleus until the cell membrane (white bar Fig. S14). AQP2 abundance was then calculated using ImageJ and calculation of the area under the IF intensity curve (represented by the yellow area in Fig. S14).

Protein isolation and Western Blot

Proteins were isolated from whole kidneys or medial kidney slices dissected into cortex and medulla. For this purpose the samples were put into RIPA buffer (50 mM Tris-HCl, 150 mM NaCl, 1 % IGEPAL, 0.5% Sodium Deoxycholate,0.1% SDS) including proteinase inhibitor (Roche, Cat.No. 11697498001) and homogenized using a 1ml tissue grinder, DOUNCE (Wheaton, USA). After 2h incubation on an orbital rotator at 4°C samples were centrifuged at 12,000 rpm (4°C) for 20 min. Proteins were quantified using BCA Protein Assay (Thermo Scientific, #23228). After denaturation at 70°C for 10 min 25 µg protein per sample were length-separated by SDS-PAGE (100V, 200mA, 2h) using NuPAGE BisTris ready gels (Invitrogen; 4-12%) and 1x MOPS (1M MOPS, 1M TrisBase, 69.3mM SDS, 20.5mM EDTA). Subsequently, proteins were blotted on a membrane (30V, 140mA, 1.5h) using transfer buffer (25mM Bicine, 25mM Bis-Tris, 1mM EDTA, 10% methanol). After blocking at RT for 1h in 1xTBST (140mM NaCl, 18mM Tris Base, 0.05% Tween20) containing either 5% milk or BSA membranes were incubated with primary antibodies either for 2h at RT or overnight at 4°C. After washing in 1xTBST membranes were incubated with secondary antibodies (1h, RT). Finally, membranes were washed again and signal detection was achieved using SuperSignal West Pico (Thermo Fisher Scientific, USA) or Amersham ECL Prime Western Blotting Detection Reagent (GE Healthcare, UK). To assess the molecular weight of

respective protein bands the Spectra™ Multicolor Broad Range Protein Ladder (Thermo Fisher Scientific, USA) was used.

Quantification of total nephron number

In an effort to quantify total nephron number whole kidneys of P30 mice were chopped into 2 mm² pieces and incubated with 5 ml 6N HCl at 37°C for 90 min. Further chopping was achieved by 10x pipetting up and down (10 ml pipette). After adding 25 ml water the well-mixed solution was analyzed. Therefore 100 µl of the solution were transferred into a petri dish with squares (1 cm x 1 cm) dividing the bottom. For each mouse total nephron number was determined 5 times and averaged.

RNA isolation, cDNA synthesis and real-time RT-PCR

Kidneys from control and *Grhl2* $^{CD\ -/-}$ mice were homogenized, and total RNA was isolated using RNeasy Mini Kit (Qiagen) according to manufacturer's instructions including treatment with RNase-free DNase I (Qiagen) for genomic DNA digestion. 500 ng of total RNA from each sample was used as template for first-strand cDNA synthesis using the RevertAid™ First Strand cDNA Synthesis Kit (Fermentas/Fisher Scientific, Schwerte, Germany) according to manufacturer's instructions. For quantitative PCR, the FastStart Universal SYBR Green Master (Rox) (Roche Diagnostics, Mannheim, Germany) system was used with cDNA as template and primers at a final concentration of 200 nM each. Primer sequences are listed in Suppl. Table S5 or described previously [8,9]. Samples were incubated at 95°C for 10 min, followed by 45 cycles of 95°C for 25 s and 60°C for 1 min. Threshold cycle (Ct) values were set in the linear phase of exponential amplification. For expression analysis, relative levels of mRNA expression were normalized for β-actin mRNA expression and calculated according to the ΔΔCt method. Statistical significance of differences between two groups was analyzed using two-sided Student's t-test.

Plasma collection and measurements

Mice were sacrificed and blood was collected, heparinized and centrifuged at 15,000 rpm for 5 min at RT. Subsequently, plasma was aliquoted and stored at -20°C. Creatinine, urea, sodium and potassium level measurements from plasma samples were carried out by Labor 28 (Berlin, Germany). For blood gas analyses, blood was collected in heparinized petri dishes and immediately analysed using an iStat handheld blood analyser and iStat cartridges CG8+ (Abbott, Illinois, USA). Copeptin analysis was carried out using Enzyme-linked Immunosorbent Assay Kit For Copeptin (Cloud-Clone Corp., Houston, USA).

Study approval

All animal studies were performed in accordance with the German animal protection act and were approved by the Berlin State Office for Health and Social Affairs (LaGeSo, Berlin, Germany).

Supplemental References

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