Supplementary Materials

The proteasomal deubiquitinating enzyme PSMD14 regulates macroautophagy by controlling Golgi-to-ER retrograde transport

Bustamante HA., et al.
Figure S1. siRNA sequences directed against human PSMD14 used for Validation Stage.

Figure S2. Primer pairs sequences used for RT-qPCR.

Figure S3. The PSMD14 DUB inhibitor CZM increases the Golgi apparatus area.

Immunofluorescence microscopy analysis of the Golgi area in parental H4 cells treated for 4 h either with the vehicle (DMSO; Control) or CZM. The Golgi marker GM130 was used to determine the region of interest in each condition. Statistical significance was determined by Student’s t-test. Bars represent the mean ± SEM (n =43 cells). ***P <0.001.

Figure S4. CZM causes the accumulation of KDEL-R1-GFP at the Golgi apparatus.

HeLa cells expressing KDEL-R1-GFP were either left untreated or treated with CZM for 30, 60 or 90 min. Cells were fixed and representative confocal images were acquired.

Figure S5. Effect of CZM on proteasome activity.

Parental H4 cells were treated either with the vehicle (DMSO; Control), CZM or MG132, for 90 min. Protein extracts were used to measure in vitro the Chymotrypsin-like peptidase activity of the proteasome. The enzymatic activity was quantified according to the cleavage of the fluorogenic substrate Suc-LLVY-AMC to AMC, and normalized to that of control cells. The statistical significance was determined by One-Way ANOVA, followed by Tukey’s test. Bars represent the mean ± SD of biological replicates (n=3). **P <0.01; n.s., not significant.

Figure S6. Effect of CZM and MG132 on basal macroautophagy.

(A) Immunofluorescence microscopy analysis of the subcellular localization of LC3 in parental H4 cells treated with either with the vehicle (DMSO; Control), CZM for 4 h or MG132 for 6 h. Cells were fixed, permeabilized and stained with a rabbit polyclonal antibody to LC3B followed by Alexa-594-conjugated donkey anti-Rabbit IgG. Scale bar 10 μm. (B) Parental H4 cells were treated as in (A) and the protein extracts were analyzed by western blot with a polyclonal antibody to LC3B. Densitometric quantification of the protein levels of LC3B were depicted as the Ratio LC3B-II/LC3B-I. The statistical significance was determined by One-Way ANOVA, followed by Tukey’s test. Bars represent the mean ± SD of biological replicates (n=3). ***P <0.001; n.s., not significant.

Figure S7. Distribution of RAB1A upon CZM treatment.

Immunofluorescence analysis of endogenous RAB1A in H4 parental cells treated either with vehicle (DMSO; Control) (A-C) or CZM for 4 h (D-F). Cells were fixed, permeabilized, and double stained with a rabbit
monoclonal antibody to RAB1A (clone D3X9S) (A and D) and a mouse monoclonal antibody to GM130 (clone35/GM130) (B and E), followed by Alexa-594-conjugated donkey anti-Rabbit IgG and Alexa-488-conjugated donkey anti-Mouse IgG. Merging of the images generated the third picture (C and F). Scale bar, 10 μm. (G) Quantitative analysis of the fraction of RAB1A colocalizing with GM130 under CZM treatment and compared to control cells. The statistical significance was determined by Student’s t-test. Bars represent the mean ± SEM of the fluorescent signal per cell area (n=173 cells). *P< 0.05.

Figure S8. ATG9A is distributed in the swollen Golgi apparatus upon CZM treatment.

Immunofluorescence analysis of endogenous ATG9A in H4 parental cells treated either with the vehicle (DMSO; Control) (A-C) or CZM for 4 h (D-F). Cells were fixed, permeabilized, and double stained with a rabbit monoclonal antibody to ATG9A (clone EPR2450(2)) (A and D) and a mouse monoclonal antibody to GM130 (clone35/GM130) (B and E), followed by Alexa-594-conjugated donkey anti-Rabbit IgG and Alexa-488-conjugated donkey anti-Mouse IgG. Merging of the images generated the third picture (C and F). Scale bar, 10 μm. (G) Quantitative analysis of the fraction of ATG9A colocalizing with GM130 under CZM treatment and compared to control cells. The statistical significance was determined by Student’s t-test. Bars represent the mean ± SEM of the fluorescent signal per cell area (n=93 cells). **P <0.01.
| siRNA # | Sequence                                  |
|---------|-------------------------------------------|
| #1      | (5’-GAACAAGUCUAUAUCUCUU-3’)               |
| #2      | (5’-GGCAUUAAUUCAUGGACUA-3’)               |
| #3      | (5’-AGAGUUGGAGGAAUGUUU-3’)               |
| #4      | (5’-GAUGGUGUGUGGUGGUUAU-3’)              |

Figure S1
| Target   | Sequence                                                                 |
|---------|--------------------------------------------------------------------------|
| hTBP1   | f(5’-TAGTCCAATGATGCCCCATAG-3’)   r(5’-TGGTCAGAGTTTGAAGAATGG-3’)          |
| hPSMD14 | f(5’-ACCTTAAGAGTTGATAGTTACTGACC-3’) r(5’-TTTAACAGTGCCAGGGAGAG-3’)        |
| hAPP    | f(5’-CCTAAAGCATTTCGAGCATG-3’)    r(5’-GTTTCCGTAACGTACCTTG-3’)            |

Figure S2
Figure S3

Golgi Area (µm²)

Control

10 µM CZM

2.53

***

Figure S3
Figure S4
Figure S5

Chymotrypsin-like peptidase activity normalized (%)

Control
10 µM CZM
10 µM MG132

90 min

15.24
n.s. **

0 25 50 75 100 125 150

100%
Figure S6

Control 10 µM CZM 10 µM MG132

LC3B

Ratio LC3B-II/LC3B-I

n.s. 4.03***

Control 10 µM CZM 10 µM MG132

Figure S6
Figure S7

Merge

10 µM CZM

RAB1A

GM130

B

Control

F

10 µM CZM

GM130

B

Control

10 µM CZM

Ratio GM130/Total (%)

Fraction RAB1A

G

60

1.08

40

20

0

Control

10 µM CZM

*
**Figure S8**

ATG9A GM130 Merge

Control

10 µM CZM

A B C

D E F

0 10 20 30 40 50

**1.19**

Fraction ATG9A

Ratio GM130/Total (%)
| Gene Symbol | NCBI Reference Sequence |
|-------------|-------------------------|
| PSMD14      | NM_005805               |
| PSMD7       | NM_002811               |
| KCTD3       | NM_016121               |
| UBE2E2      | NM_152653               |
| NACA        | NM_005594               |
| EPN1        | NM_013333               |
| SIAH2       | NM_005067               |
| UBA52       | NM_003333               |
| EIF3S5      | NM_003754               |
| MARK4       | NM_031417               |
| UBC         | NM_021009               |
| UBE2E3      | NM_182678               |
| RBM6        | NM_005777               |
| ZBTB12      | NM_181842               |
| PHF12       | NM_020889               |
| DNAJB2      | NM_001039550            |
| BIRC7       | NM_022161               |
| KBTBD2      | NM_015483               |
| RYBP        | NM_012234               |
| NEURL       | NM_004210               |
| HECTD3      | NM_024602               |
| ZNF592      | NM_014630               |
| FLJ25076    | XM_940609               |
| TNK2        | NM_001010938            |
| PRPF8       | NM_006445               |
| TRIM31      | NM_052816               |
| UCHL3       | NM_006002               |
| UBE2D4      | NM_015983               |
| MDM4        | NM_002393               |
| TRIM63      | NM_032588               |
| UBE2J1      | NM_016021               |
| DDI2        | NM_032341               |
| RNF146      | NM_030963               |
| CHD5        | NM_015557               |
| CISH        | NM_145071               |
| SENP8       | NM_145204               |
| FLJ43374    | NM_198582               |
| HIP2        | NM_005339               |
| UBE2V1      | NM_001032288            |
| ZNF216      | NM_006007               |
| KIAA1536    | NM_020898               |
| WDR11       | NM_018117               |
| SH3RF2      | NM_152550               |
| RAI17       | NM_020338               |
| PCGF2       | NM_007144               |
| RNF34       | NM_025126               |
| FBXO4       | NM_012176               |
| RNF141      | NM_016422               |
| BRF3        | NM_015695               |
| CAND2       | XM_944849               |
| UBXD4       | NM_181713               |
| TRIM23      | NM_033228               |
| FAU         | NM_001997               |
| RSPRY1      | NM_133368               |
| TRIM42      | NM_152616               |
| FBXW10      | NM_031456               |
| MDM2        | NM_006879               |
| TOM1        | NM_005488               |
| SOCS3       | NM_003955               |
| FBXO44      | NM_183413               |
| RNF130      | NM_018434               |
| CREBL1      | NM_004381               |
| RNF39       | NM_170770               |
| HRC         | NM_002152               |
| VPRBP       | NM_014703               |
| FAF1        | NM_131917               |
| PSMD4       | NM_002810               |
| RNF187      | XM_047499               |
| SHFM3       | NM_022039               |
| EIF2AK4     | NM_001013703            |
| SUMO2       | NM_001005849            |
| FLJ20280    | NM_017741               |
| TCEB1       | NM_005648               |
| RAMP        | NM_016448               |
| PHF23       | NM_024297               |
| KUA-UEV     | NM_003349               |
| NICE-4      | NM_014847               |
| UBB         | NM_018955               |
| ZBTB16      | NM_001018011            |
| OTUD5       | NM_017602               |
| ASPSCR1     | NM_024083               |
| LOC652557   | XM_942059               |
| SF3B3       | NM_012426               |
| LGALS3BP    | NM_005567               |
| TRIM56      | NM_030961               |
| SAE1        | NM_005500               |
| KLHL1       | NM_020866               |
| MNAT1       | NM_002431               |
| KCTD17      | NM_024681               |
| Gene   | Accession   |
|--------|-------------|
| PCF11  | NM_015885   |
| USP42  | NM_032172   |
| PHF21A | NM_016621   |
| TRIM74 | NM_198853   |
| KLHL7  | NM_001031710|
| RNF32  | NM_030936   |
| TRIM60 | NM_152620   |
| UBE2D2 | NM_003339   |
| UBC1   | NM_016406   |
| TA-KRP | NM_032505   |
| UBE2J2 | NM_194457   |
| RANBP9 | NM_005493   |
| BMI1   | NM_005180   |
| PC326  | NM_001017977|
| EIF3S3 | NM_003756   |
| CDC34  | NM_004359   |
| UBXD3  | NM_152376   |
| KCND1  | NM_004979   |
| PEX10  | NM_002617   |
| USP52  | NM_014871   |
| PLAA   | NM_001031689|
| BMI1   | NM_005180   |
| PDXRN4 | NM_013377   |
| FLJ25555| NM_152345  |
| BIRC2  | NM_001166   |
| STAMBPL1| NM_020799  |
| MIB2   | NM_080875   |
| PIA51  | NM_016166   |
| TRIM7  | NM_203294   |
| LL0XNC01-237H1.1 | NM_001031834|
| USP9Y  | NM_004654   |
| TRIM33 | NM_033020   |
| LOC646862| XM_929820  |
| TSG101 | NM_006292   |
| TRIM6-TRIM34| NM_001003819|
| FBXO2  | NM_012168   |
| WDR26  | NM_025160   |
| SKP1A  | NM_170679   |
| CUL5   | NM_003478   |
| C13ORF22| NM_005800  |
| TRAF7  | NM_206835   |
| RBM10  | NM_152856   |
| FBXL20 | NM_032875   |
| ASB18  | NM_212556   |
| LONRF2 | NM_198461   |

| Gene   | Accession   |
|--------|-------------|
| USP6   | NM_004505   |
| KCMF1  | NM_020122   |
| VPS11  | NM_021729   |
| KRTAP5-9| NM_005553  |
| USP26  | NM_031907   |
| USP16  | NM_001001992|
| USP8   | NM_005154   |
| KCTD12 | NM_138444   |
| USP10  | NM_005153   |
| RPS27A | NM_002954   |
| UBE2M  | NM_003969   |
| LOC51035| NM_015853  |
| RKHD1  | NM_203304   |
| HACE1  | NM_020771   |
| FANCD2 | NM_001018115|
| YAF2   | NM_005748   |
| SIP    | NM_001007214|
| RNF44  | NM_014901   |
| ZNFI51 | NM_003443   |
| ZRANB1 | NM_017580   |
| TCEB2  | NM_207013   |
| TCEB3  | NM_003198   |
| RNF186 | NM_019062   |
| LOC441061| XM_941081 |
| BTBD14A| NM_144653   |
| LOC646862| XM_929820  |
| LMO7   | NM_005358   |
| FLJ10719| NM_018193  |
| AB026190| NM_014458  |
| UBE2NL | NM_001012989|
| FBXO5  | NM_012177   |
| HECTD1 | NM_015382   |
| DKKFZP47C195| NM_207343 |
| TRIM32 | NM_012210   |
| HECW1  | NM_015052   |
| AIRE   | NM_00659    |
| KCNC1  | NM_004976   |
| UNK    | NM_001080419|
| TRIM8  | NM_030912   |
| SBBi54 | NM_138334   |
| C200RF18| NM_031227  |
| RNF167 | NM_015528   |
| KCNA1  | NM_000217   |
| OTUB2  | NM_023112   |
| SPSB2  | NM_032641   |
| Gene | Accession |
|------|-----------|
| GGA3 | NM_014001 |
| SPSB3 | NM_080861 |
| SHARPIN | NM_030974 |
| HGS | NM_004712 |
| TIPI20A | NM_018448 |
| UEVLD | NM_018314 |
| ATG10 | NM_031482 |
| CHD4 | NM_001273 |
| FBXO34 | NM_017943 |
| UBQLN2 | NM_013444 |
| ZNF185 | NM_007150 |
| FBXO17 | NM_148169 |
| ANKFY1 | NM_020740 |
| USP43 | XM_371015 |
| PARC | NM_015089 |
| HR | NM_018411 |
| ZNF297B | NM_014007 |
| UBL5 | NM_024292 |
| PHF19 | NM_001009936 |
| KCTD5 | NM_018992 |
| MARCH4 | NM_020814 |
| ASB14 | NM_130387 |
| FLJ34154 | NM_173813 |
| HUWE1 | NM_031407 |
| ZBTB1 | NM_014950 |
| FBXL22 | NM_203373 |
| RNF207 | NM_207396 |
| RFWD3 | NM_018124 |
| UBE2L6 | NM_004223 |
| PHF16 | NM_014735 |
| MARCH8 | NM_001002266 |
| FBXL14 | NM_152441 |
| BACH2 | NM_021813 |
| DDB1 | NM_001923 |
| TRIM2 | NM_015271 |
| RNF38 | NM_194331 |
| DTX3 | NM_178502 |
| SH3MD4 | XM_293090 |
| NSMCE1 | NM_145080 |
| PML | NM_033247 |
| C9ORF60 | NM_06336 |
| SENP1 | NM_014554 |
| SIAH1 | NM_003031 |
| CCL20 | NM_004591 |
| COPS7A | NM_016319 |
| USP45 | XM_371838 |
| PHF5A | NM_032758 |
| UBE4B | NM_006048 |
| KLIHDC5 | NM_020782 |
| KCNC3 | NM_004977 |
| RNF121 | NM_194542 |
| PARK7 | NM_007262 |
| UBE2N | NM_003348 |
| CUEDC1 | NM_017949 |
| BARD1 | NM_000465 |
| TAB3 | NM_198312 |
| FBXL13 | NM_145032 |
| MID2 | NM_052817 |
| FBXW5 | NM_178226 |
| PRPF19 | NM_014502 |
| WDR40A | NM_015397 |
| RAB40C | NM_021168 |
| FBXL12 | NM_017705 |
| BTBD9 | NM_152733 |
| PHF6 | NM_032335 |
| LRRRC29 | NM_001004055 |
| USP54 | NM_152586 |
| HSHIN6 | NM_207320 |
| MYO6 | NM_004999 |
| FBXL2 | NM_012157 |
| FBXO39 | NM_153230 |
| UBE2H | NM_182697 |
| ZNF131 | NM_003432 |
| LATS1 | NM_004690 |
| EEA1 | NM_003566 |
| ITCH | NM_031483 |
| BAZ1B | NM_032408 |
| RFP | NM_030950 |
| TOM1L1 | NM_005486 |
| BIRC3 | NM_182962 |
| MSL2L1 | NM_018133 |
| BRE | NM_199191 |
| WDR71 | NM_025155 |
| NOSIP | NM_015953 |
| RUFY1 | NM_025158 |
| COPS4 | NM_016129 |
| LOC392188 | XM_373238 |
| TRIM29 | NM_058193 |
| VPS41 | NM_080631 |
| ATG16L1 | NM_198890 |
| Gene  | Accession   |
|-------|-------------|
| FEM1C | NM_020177   |
| ATG7  | NM_006395   |
| C17ORF27 | NM_020914 |
| RNF215 | NM_001017981 |
| SYVN1 | NM_032431   |
| TRIM73 | NM_198924   |
| KBTBD4 | NM_018095   |
| CPSF1 | NM_013291   |
| NEURL2 | NM_080749   |
| FBXO3 | NM_033406   |
| NLRC5 | NM_032206   |
| KCTD15 | NM_024076   |
| HIC2  | NM_015094   |
| RNF12 | NM_016120   |
| KIAA0363 | XM_001717181 |
| SPRYD5 | NM_032681   |
| CUL4A | NM_003589   |
| LOC92312 | XM_937993 |
| HOZFP | NM_152995   |
| PHF11 | NM_016119   |
| LOC653192 | XM_926437 |
| REC14 | NM_025234   |
| TZFP  | NM_014383   |
| UBE2A | NM_181762   |
| RNF165 | NM_152470   |
| LNX2  | NM_153371   |
| RNF208 | NM_031297   |
| FBXW12 | NM_207102   |
| SMARCA3 | NM_139048   |
| FEM1B | NM_015322   |
| MLL3  | NM_021230   |
| RHOBTB2 | NM_015178   |
| SFRS21P | NM_004719   |
| USP3  | NM_006537   |
| DPF1  | NM_004647   |
| NEDD4 | NM_006154   |
| PHF13 | NM_153812   |
| REV3L | NM_002912   |
| NEDD4L | NM_015277   |
| M96   | NM_007358   |
| GGA2  | NM_015044   |
| SUMO3 | NM_006936   |
| ASB6  | NM_177999   |
| TRIM36 | NM_018700   |
| PIAS54 | NM_015897   |

| Gene  | Accession   |
|-------|-------------|
| MGC3123 | NM_024107  |
| FBXO11 | NM_012167   |
| TRAF5  | NM_001033910 |
| BRIP1  | NM_032043   |
| TNIP2  | NM_024309   |
| RANBP2 | NM_006267   |
| ASB12  | NM_130388   |
| ANUBL1 | NM_001128324 |
| KLHL6  | NM_130446   |
| UBE2F  | NM_080678   |
| NPL4   | NM_017921   |
| RBAF600 | NM_020765 |
| SNF1LK | NM_173354   |
| FBXL16 | NM_153350   |
| SUMO4  | NM_001002255 |
| KCNA4  | NM_002233   |
| TIF1   | NM_003852   |
| USP39  | NM_006590   |
| SOCS4  | NM_080867   |
| USP27X | XM_372213   |
| USP7   | NM_003470   |
| FBXL17 | NM_022824   |
| DKFZP564O0463 | NM_015420 |
| ARH1   | NM_005744   |
| USP41  | XM_036729   |
| TNFAIP3 | NM_006290  |
| FBXO43 | NM_001029860 |
| ZNF179 | NM_007148   |
| PCGF1  | NM_032673   |
| ZNF265 | NM_203350   |
| KCNA3  | NM_002232   |
| TRIM25 | NM_005082   |
| CDC20  | NM_001255   |
| DCUN1D1 | NM_020640  |
| ZBTTB2 | NM_020861   |
| PDZRN3 | NM_015009   |
| LZTR1  | NM_006767   |
| GCL    | NM_178439   |
| CUL1   | NM_003592   |
| PHF17  | NM_199320   |
| KCTD10 | NM_031954   |
| RWDD3  | NM_001128142 |
| USP15  | NM_006313   |
| PHF7   | NM_173341   |
| MLLT10 | NM_001009569 |
| Gene   | Accession       |
|--------|----------------|
| TRIM9  | NM_052978      |
| MARCH7 | NM_022826      |
| RNF43  | NM_017763      |
| USP22  | XM_042698      |
| MARCH6 | NM_005885      |
| UBE2Q1 | NM_017582      |
| PCCF3  | NM_006315      |
| SYTL3  | NM_001009991   |
| RNF148 | NM_198085      |
| UBADC1 | NM_016172      |
| STAMBP | NM_201647      |
| UBE1L  | NM_003335      |
| TRIM46 | NM_025058      |
| DDB2   | NM_000107      |
| UBE2L3 | NM_003347      |
| TBL1XR1| NM_024665      |
| CUL2   | NM_003591      |
| WDSUB1 | NM_152528      |
| BMSC-UBP | NM_201265   |
| PPIL2  | NM_014337      |
| FLJ13456| NM_024646     |
| BTBD12 | NM_032444      |
| KCTD13 | NM_178863      |
| SKP2   | NM_032637      |
| KCNS3  | NM_002252      |
| UBE1   | NM_153280      |
| UBE3A  | NM_130838      |
| LOC196394| NM_207337    |
| HERC1  | NM_003922      |
| RNF6   | NM_183045      |
| ATG3   | NM_022488      |
| IMPACT | NM_018439      |
| UBE3B  | NM_183415      |
| KIAA0459| XM_375697     |
| CNOT4  | NM_001008225   |
| TRIM40 | NM_138700      |
| SIK2   | NM_015191      |
| BRPF1  | NM_004634      |
| ZFPL1  | NM_006782      |
| ZNF313 | NM_018683      |
| AOF1   | NM_153042      |
| TRIM71 | NM_001039111   |
| TRAF6  | NM_004620      |
| KLHL13 | NM_033495      |
| H326   | NM_015726      |
| HERC2  | NM_004667      |
| UBE2D1 | NM_003338      |
| ZBTB39 | NM_014830      |
| RNF133 | NM_139175      |
| USP21  | NM_012475      |
| UBE3C  | NM_014671      |
| NIPBL  | NM_015384      |
| FBXO38 | NM_030793      |
| FLJ11280| NM_001040217  |
| ASB11  | NM_001012428   |
| FLJ40411| NM_001080504  |
| LOC342897| NM_001001414  |
| UBE2I  | NM_194260      |
| CXXC1  | NM_014593      |
| UBE1C  | NM_198197      |
| WSB2   | NM_018639      |
| SMURF1 | NM_181340      |
| NXF2   | NM_022053      |
| FLJ46299| NM_207335     |
| FBXO27 | NM_178820      |
| WDR21  | NM_181341      |
| D8S2298E| NM_005671     |
| TRIP   | NM_005879      |
| RNF8   | NM_183078      |
| PCCG6  | NM_032154      |
| TRIM58 | NM_015431      |
| JARID1C| NM_004187      |
| PHF10  | NM_018288      |
| ZNF499 | NM_032792      |
| NEDD8  | NM_006156      |
| DCUN1D5| NM_032299      |
| TRIAD3 | NM_019011      |
| PJA1   | NM_001032396   |
| JARID1D| NM_004653      |
| UBE2C  | NM_181803      |
| HECW2  | NM_020760      |
| KCNA7  | NM_031886      |
| UBE1DC1| NM_024818      |
| PHF20  | NM_016436      |
| KEAP1  | NM_012289      |
| LOC441920| XM_497731     |
| RWDD2  | NM_033411      |
| RNF157 | NM_052916      |
| KIAA0795| NM_025010     |
| FBXO31 | NM_024735      |
| Gene     | Accession  |
|----------|------------|
| C20orf11 | NM_017896  |
| Phf1     | NM_002636  |
| Kiaa0644 | NM_014817  |
| Trim45   | NM_025188  |
| Znf547   | NM_173631  |
| Loc342931| XM_292796  |
| Znf294   | NM_015565  |
| Ube2g1   | NM_182682  |
| Kbtbd11  | NM_014867  |
| Rnf31    | NM_017999  |
| Rnf169   | XM_495886  |
| Mgc20470 | NM_145053  |
| Cdc27    | NM_001256  |
| Traff4   | NM_145751  |
| Kctd7    | NM_153033  |
| Tulp4    | NM_00107466|
| Pias2    | NM_173206  |
| IPP      | NM_005897  |
| Asb10    | NM_080871  |
| Uhrf2    | NM_152896  |
| Senp7    | NM_020654  |
| Moes3    | NM_014484  |
| Ube2b    | NM_003337  |
| Usp14    | NM_001037334|
| Znf645   | NM_152577  |
| Loc283219| NM_001029859|
| Ube2o    | NM_022066  |
| Ube2r2   | NM_017811  |
| Dpf3     | NM_012074  |
| Loc648245| XM_942858  |
| Loc648245| XM_942858  |
| Rag1     | NM_000448  |
| C10orf3  | NM_018131  |
| Stub1    | NM_005861  |
| Stam     | NM_003473  |
| Soes1    | NM_003745  |
| Irf2bp1  | NM_015649  |
| Kiaa0999 | NM_025164  |
| Phf3     | NM_015153  |
| Cops8    | NM_006710  |
| Uap1     | NM_016525  |
| Kctd6    | NM_001128214|
| Rad23a   | NM_005053  |
| Dmrt3    | NM_021240  |
| Kbtbd9   | XM_496546  |
| Birc6    | NM_016252  |
| Ibrdc2   | NM_182757  |
| Mark1    | NM_018650  |
| Tank     | NM_133484  |
| Loc196394| NM_207337  |
| Poli     | NM_007195  |
| Jarid1b  | NM_006618  |
| Ndp52    | NM_005831  |
| Soes7    | NM_014598  |
| Kbtbd1   | NM_001003760|
| Kcnd2    | NM_012281  |
| Senp3    | NM_015670  |
| Dre1     | NM_017644  |
| Lonrf1   | NM_152271  |
| Usp29    | NM_020903  |
| Mkl1n    | NM_013255  |
| Flj35834 | NM_178827  |
| Dcun1d2  | NM_001014283|
| Fbxo47   | NM_00108777|
| Cyld     | NM_015247  |
| Khhl21   | NM_014851  |
| Cxorf53  | NM_001018055|
| Soes6    | NM_004232  |
| Rnf41    | NM_194359  |
| Han11    | NM_001003725|
| Bazz2b   | NM_013450  |
| Rnf126   | NM_017876  |
| Dkfp761g2113 | NM_001098833|
| Wdr24    | NM_032259  |
| Mid1     | NM_033290  |
| Ubph     | NM_019116  |
| Loc643904| XM_927169  |
| Loc644006| XM_929433  |
| Kcna2    | NM_004974  |
| Brodl    | NM_153252  |
| C14orf4  | NM_024496  |
| Adrm1    | NM_175573  |
| Tdrd3    | NM_030794  |
| Kcnv1    | NM_014379  |
| Kcnc2    | NM_139137  |
| Kcncc2   | NM_139137  |
| Klhl9    | NM_018847  |
| Wwp1     | NM_007013  |
| Pias3    | NM_006099  |
| Ubd      | NM_006398  |
| Ubd      | NM_003940  |
| Gene     | Accession  |
|----------|------------|
| FBXL7    | NM_012304  |
| ZNF336   | NM_022482  |
| ZFAND6   | NM_019006  |
| RCBTB1   | NM_018191  |
| UBXD1    | NM_025241  |
| IBRDC1   | NM_152553  |
| FLJ11078 | NM_018316  |
| UBE2S    | NM_014501  |
| LOC130617| NM_138802  |
| WHSC1    | NM_007331  |
| PPI15    | NM_203467  |
| DZIP3    | NM_014648  |
| DCUN1D3  | NM_173475  |
| HIC1     | NM_006497  |
| MED8     | NM_001001654|
| ZNF482   | NM_006626  |
| PHF21B   | NM_138415  |
| TRIM15   | NM_052812  |
| KLHL15   | NM_030624  |
| ZNRF1    | NM_032268  |
| LOC645402| XM_928448  |
| FLJ31951 | NM_144726  |
| KCTD14   | NM_023930  |
| SYTL4    | NM_080737  |
| ASC1P100 | NM_032204  |
| LINCR    | XM_930227  |
| C16orf28 | NM_023076  |
| FBXO46   | XM_371179  |
| TRIM75   | XM_939332  |
| AUP1     | NM_181857  |
| RNF40    | NM_014771  |
| FBXO18   | NM_178150  |
| CCNB1IP1 | NM_182849  |
| TOLLIP   | NM_019009  |
| KIAA1542 | NM_020901  |
| CHC1L    | NM_001268  |
| FBXL11   | NM_012308  |
| TRIM37   | NM_001005207|
| ZBTB33   | NM_006777  |
| OTUD6B   | NM_016023  |
| RNF183   | NM_145051  |
| UBDT1    | NM_024954  |
| ASB7     | NM_024708  |
| SENP2    | NM_021627  |
| HERC3    | NM_014606  |
| KBTBD5   | NM_152393  |
| TNIP1    | NM_006058  |
| LOC64219 | XM_936370  |
| MGC3306  | NM_024116  |
| ZNF295   | NM_020727  |
| HKR3     | NM_005341  |
| RNF182   | NM_152737  |
| HERPUD1  | NM_00101990|
| POLK     | NM_016218  |
| TRIM3    | NM_033278  |
| LOC137886| NM_001077619|
| VPS18    | NM_020857  |
| SNRK     | NM_017719  |
| EPS15    | NM_001981  |
| RNF2     | NM_007212  |
| ZNF278   | NM_032051  |
| DTX3L    | NM_138287  |
| DAXX     | NM_001350  |
| LOC388419| NM_001080466|
| PRICKLE1 | NM_153026  |
| LOC342931| XM_292796  |
| RFPL1    | NM_021026  |
| FBXL19   | NM_019085  |
| DD11     | NM_001001711|
| FBXO9    | NM_012347  |
| TRIM62   | NM_018207  |
| MYLIP    | NM_013262  |
| HECTD2   | NM_173497  |
| TRIM26   | NM_003449  |
| FBXL10   | NM_001005366|
| PCGF5    | NM_032373  |
| BFA1     | NM_016561  |
| ZNF330   | NM_014487  |
| SOC      | NM_001077262|
| ZBTB3    | NM_024784  |
| UBQLN1   | NM_053067  |
| WHSC1L1  | NM_017778  |
| LGR6     | NM_001017404|
| USP5     | NM_003481  |
| ASB5     | NM_080874  |
| DERL1    | NM_024295  |
| DPF2     | NM_006268  |
| MLL2     | NM_003482  |
| FBXO42   | NM_018994  |
| SENP5    | NM_152699  |
| Gene       | Accession   |
|------------|-------------|
| TRIM72     | NM_001008274|
| C10orf46   | NM_153810   |
| KCNC4      | NM_153763   |
| MLLT6      | NM_005937   |
| TRIM38     | NM_006355   |
| TRIM55     | NM_184087   |
| SOLH       | NM_005632   |
| USP25      | NM_013396   |
| MAP3K7IP2  | NM_015093   |
| RNF17      | NM_031994   |
| BTBD3      | NM_181443   |
| SSA1       | NM_003141   |
| ZBTB9      | NM_152735   |
| TRIM43     | NM_138800   |
| SCA7       | NM_000333   |
| BTBD1      | NM_001011885|
| TRIM49     | NM_020358   |
| KIAA1811   | NM_032430   |
| BTBD2      | NM_017797   |
| ASB3       | NM_145863   |
| C6orf113   | NM_145062   |
| FBXO25     | NM_012173   |
| TRIM54     | NM_187841   |
| ZFP161     | NM_003409   |
| PHGDH1     | NM_177967   |
| FBXL6      | NM_024555   |
| UBE1L2     | NM_018227   |
| UBE2V2     | NM_003350   |
| EDD1       | NM_015902   |
| LOC51255   | NM_016494   |
| USP11      | NM_004651   |
| C14orf130  | NM_175748   |
| CDC23      | NM_004661   |
| MGC10765   | NM_024345   |
| LOC652673  | XM_942254   |
| KIAA0804   | NM_015303   |
| LOC153918  | NM_001013623|
| LOC164153  | NM_203412   |
| VHL        | NM_198156   |
| FLJ32642   | NM_152415   |
| RFP2       | NM_005798   |
| AKTIP      | NM_022476   |
| USP44      | NM_032147   |
| JOSD1      | NM_014876   |
| COPS7B     | NM_022730   |
| FLJ10916   | NM_018271   |
| SENP6      | NM_015571   |
| KIAA1333   | NM_017769   |
| BTBD14B    | NM_052876   |
| LMTK3      | XM_055866   |
| KIAA1164   | NM_00104053 |
| TTC3       | NM_001001894|
| USP20      | NM_001008563|
| RNF13      | NM_183384   |
| TOM1L2     | NM_144678   |
| MARCH1     | NM_017923   |
| UBE2G2     | NM_003343   |
| RNF10      | NM_014868   |
| LNX1       | NM_032622   |
| UBE2U      | NM_152489   |
| PXMP3      | NM_000318   |
| UBE2T      | NM_014176   |
| SUMO1      | NM_001005781|
| SCEL       | NM_003843   |
| KCTD16     | NM_020768   |
| CUL3       | NM_003590   |
| RAB40A     | NM_080879   |
| ZNF509     | NM_145291   |
| CDC16      | NM_003903   |
| KHL5       | NM_199039   |
| LOC339745  | NM_001001664|
| TRIM67     | NM_001004342|
| WDR59      | NM_030581   |
| ASB13      | NM_024701   |
| NSD1       | NM_172349   |
| BTBD5      | NM_017658   |
| RCHY1      | NM_001009922|
| MARC2      | NM_001005416|
| NUP153     | NM_005124   |
| GTF2H2     | NM_001515   |
| RC3H2      | NM_018835   |
| LOC345930  | XM_941136   |
| USP48      | NM_001032730|
| USP35      | XM_290527   |
| FBXO15     | NM_152676   |
| USP9X      | NM_021906   |
| RNF111     | NM_017610   |
| CBX4       | NM_003655   |
| ZNF598     | NM_178167   |
| CBLL1      | NM_024814   |
| Gene   | Accession   |
|--------|-------------|
| N4BP2  | NM_018177   |
| WRNIP1 | NM_130395   |
| KCNA6  | NM_002235   |
| BCL6   | NM_001706   |
| BTBD7  | NM_018167   |
| UBE2Q2 | NM_173469   |
| KCNA5  | NM_002234   |
| USP12  | NM_182488   |
| EPN2   | NM_148921   |
| C22ORF3| NM_012265   |
| BTBD4  | NM_025224   |
| CBL    | NM_005188   |
| UBXD2  | NM_014607   |
| C1orf166| NM_024544   |
| UBAP2  | NM_020867   |
| HYPK   | NM_016400   |
| DMRTA1 | NM_022160   |
| ARIH1  | NM_005744   |
| CCDC50 | NM_174908   |
| PARP11 | NM_020367   |
| CCNF   | NM_001761   |
| COPS6  | NM_006833   |
| USP18  | NM_017414   |
| RNF168 | NM_152617   |
| BTRC   | NM_003939   |
| LMO6   | NM_006150   |
| PHF14  | NM_00107157 |
| OTUD1  | XM_166659   |
| KCNG1  | NM_002237   |
| KCTD9  | NM_017634   |
| PROSAPIP2| NM_014726  |
| ZFYVE20| NM_022340   |
| TNFRSF25| NM_148970  |
| TRIM28 | NM_005762   |
| RKHD3  | NM_032246   |
| ASB2   | NM_016150   |
| ATF6   | NM_007348   |
| MYSM1  | XM_055481   |
| ETEA   | NM_014613   |
| USP2   | NM_171997   |
| SHPRH  | NM_173082   |
| PHF20L1| NM_032205   |
| UHRF1  | NM_013282   |
| PRICKLE2| NM_198859   |
| LOC120126| XM_936270  |
| EGLN2  | NM_080732   |
| HERC4  | NM_00101792 |
| USP32  | NM_032582   |
| MGC29814| NM_182565   |
| OTUD7  | NM_130901   |
| C6ORF49| NM_013977   |
| ZSWIM2 | NM_182521   |
| UBL4   | NM_014235   |
| USP28  | NM_020866   |
| ZNRF2  | NM_147128   |
| ANKR13 | NM_033121   |
| ABTB2  | NM_145804   |
| TRAF3  | NM_003300   |
| STK29  | NM_003957   |
| KLHL12 | NM_021633   |
| MARCH3 | NM_178450   |
| MGC10198| NM_152682   |
| ARIH2  | NM_006321   |
| C7ORF21| NM_031434   |
| ATG5   | NM_004849   |
| EPS15L1| NM_021235   |
| KLHL8  | NM_020803   |
| FSD1L  | NM_031919   |
| FBXWI1 | NM_033645   |
| ASB9   | NM_001031739|
| FBXW9  | NM_032301   |
| KLHL11 | NM_018143   |
| MARCH9 | NM_138396   |
| RNF14  | NM_183399   |
| RFPL3  | NM_006604   |
| LATS2  | NM_014572   |
| LOC340359| NM_001081675|
| TRIM39 | NM_172016   |
| INTS12 | NM_020395   |
| LOC120126| XM_936270  |
| ERCC5  | NM_000123   |
| YOD1   | NM_018566   |
| USP49  | NM_018561   |
| NHLRC1 | NM_198586   |
| RFC1   | NM_002913   |
| MARK2  | NM_004954   |
| FBXO28 | NM_015176   |
| TRIM64 | XM_061890   |
| SQSTM1 | NM_003900   |
| WSB1   | NM_134265   |
| Gene       | NM_ Identifier |
|-----------|----------------|
| USP30     | NM_032663      |
| FBXO21    | NM_015002      |
| BTBD8     | NM_183242      |
| UBQLN3    | NM_017481      |
| VCP       | NM_007126      |
| MIB1      | NM_020774      |
| LOC399940 | XM_374920      |
| RNF190    | NM_152998      |
| USP1      | NM_001017416   |
| MEFV      | NM_000243      |
| TRIM11    | NM_145214      |
| FBXL4     | NM_012160      |
| BAP1      | NM_004656      |
| TRIM17    | NM_001024941   |
| UBA2      | NM_005499      |
| TTRAP     | NM_016614      |
| EPN3      | NM_017957      |
| USP50     | NM_203494      |
| ANAPC10   | NM_014885      |
| FBXL15    | NM_024326      |
| KLHL14    | NM_020805      |
| FRBZ1     | NM_194314      |
| TRIM68    | NM_018073      |
| DUB3      | NM_201402      |
| TNFAIP1   | NM_021137      |
| BAHD1     | NM_014952      |
| ZNRF3     | XM_290972      |
| SOCS5     | NM_014011      |
| FLJ14981  | NM_032868      |
| TRIM5     | NM_033092      |
| UFD1L     | NM_001035247   |
| KBTBD6    | NM_152903      |
| RNF125    | NM_017831      |
| KBTBD3    | NM_152433      |
| MKRN3     | NM_005664      |
| KCNA10    | NM_005549      |
| ATRX      | NM_138270      |
| DKFZP547N043 | NM_032018   |
| XPA       | NM_000380      |
| USP38     | NM_032557      |
| BRCA1     | NM_007298      |
| UBASH3A   | NM_001001895   |
| RNF113A   | NM_006978      |
| ZFP67     | NM_015872      |
| ENC1      | NM_003633      |
|           |                |
| HBXAP     | NM_016578      |
| KIAA1018  | NM_014967      |
| UBR1      | NM_174916      |
| LOC51136  | NM_016125      |
| KCNRM     | NM_173605      |
| KLHDC2    | NM_014315      |
| MGC33190  | NM_152749      |
| TRIM59    | NM_173084      |
| MYNN      | NM_018657      |
| FBXL3A    | NM_012158      |
| ANAPC2    | NM_013366      |
| MKRN2     | NM_014160      |
| RNF122    | NM_023787      |
| NEURL1B   | NM_00142651    |
| KIAA1718  | NM_030647      |
| PHF15     | NM_015288      |
| KLHL3     | NM_017415      |
| OPTN      | NM_021980      |
| ZNF46     | NM_006977      |
| RAP80     | NM_016290      |
| ATG12     | NM_004707      |
| C6ORF157  | NM_198920      |
| RBX1      | NM_014248      |
| ANKRD9    | NM_152326      |
| IVNS1ABP  | NM_006469      |
| RNF138    | NM_198128      |
| POLH      | NM_006502      |
| DMRTA2    | NM_032110      |
| FBXL18    | NM_024963      |
| UCHL5     | NM_015984      |
| FBXO30    | NM_032145      |
| RNF149    | NM_173647      |
| HERC5     | NM_016323      |
| OTUD4     | NM_017493      |
| USP31     | NM_020718      |
| ZA20D1    | NM_020205      |
| OTUB1     | NM_017670      |
| FBXW8     | NM_012174      |
| NYREN18   | NM_016118      |
| MGC4634   | NM_153340      |
| KCTD4     | NM_198404      |
| RNF135    | NM_197939      |
| ZNF364    | NM_014455      |
| CDC26     | NM_139286      |
| MAP3K1    | XM_042066      |
| Gene   | Accession  |
|--------|------------|
| USP53  | NM_019050  |
| MKRN1  | NM_013446  |
| HDAC6  | NM_006044  |
| BACH1  | NM_001011545 |
| ASB16  | NM_080863  |
| FLN29  | NM_006700  |
| CUL7   | NM_014780  |
| MGC71999 | NM_199290 |
| DTX1   | NM_004416  |
| FBXO36 | NM_174899  |
| BIRC8  | NM_033341  |
| DHX57  | NM_198963  |
| RC3H1  | NM_172071  |
| RFWD2  | NM_001001740 |
| BTBD11 | NM_152322  |
| KCTD8  | NM_198353  |
| TRIM35 | NM_015066  |
| RAB40B | NM_006822  |
| ZRANB3 | NM_032143  |
| USP19  | NM_006677  |
| FBXL8  | NM_018378  |
| RHOBTB3| NM_014899  |
| USP47  | NM_017944  |
| BTBD6  | NM_033271  |
| SMARCAD1 | NM_020159 |
| APM-1  | XM_113971  |
| NEIL3  | NM_018248  |
| KIAA0478 | NM_014870 |
| RING1  | NM_002931  |
| VCP1P1 | NM_025054  |
| CGRRF1 | NM_006568  |
| MGC22679 | NM_144711 |
| RFFL   | NM_001017368 |
| DCUN1D4| NM_015115  |
| ANAPC1 | NM_022662  |
| GMRP-1 | NM_032320  |
| RABGEF1| NM_014504  |
| LOC645836 | XM_001720764 |
| FLJ34960 | NM_153270 |
| USP17  | NM_00105662 |
| FLJ31031| NM_182333 |
| VPS13D | NM_018156  |
| KIAA1900 | NM_052904 |
| ANKRD9 | NM_152326  |
| UBL3   | NM_007106  |
| UBE2W  | NM_001001482 |
| FBXO32 | NM_148177  |
| GIP2   | NM_005101  |
| KIAA1582 | NM_018996  |
| DTX2   | NM_020892  |
| ZBTB26 | NM_020924  |
| USP34  | NM_014709  |
| TOPORS | NM_005802  |
| RNF150 | NM_020724  |
| LOC90637 | NM_182491 |
| C1ORF6 | NM_020131  |
| KLHDC3 | NM_057161  |
| FLJ13063 | NM_001105247 |
| FLJ39827 | NM_152424 |
| LOC731049 | XM_001724228 |
| FBXO8  | NM_012180  |
| MARCH5 | NM_017824  |
| KCTD1  | NM_198991  |
| RNF139 | NM_007218  |
| ASB8   | NM_024095  |
| ANKIB1 | XM_377955  |
| PDC    | NM_022576  |
| RNF128 | NM_024539  |
| TBL1XR1| NM_024665  |
| LOC285498 | NM_194439 |
| TRIM47 | NM_033452  |
| ASB15  | NM_080928  |
| USP46  | NM_022832  |
| MGRN1  | NM_015246  |
| SH3MD2 | NM_020870  |
| IBRDC3 | NM_153341  |
| RAD18  | NM_020165  |
| TRIM52 | NM_032765  |
| ZBTB11 | NM_014415  |
| C16orf44 | NM_024731 |
| RNF175 | NM_173662  |
| MGC10067 | NM_145049 |
| TRIM34 | NM_001003827 |
| SPSB1  | NM_025106  |
| KIAA0317 | NM_014821 |
| PEX12  | NM_000286  |
| TRFP   | NM_004275  |
| MGC2629 | NM_032522 |
| RNF103 | NM_005667  |
| FLJ13096 | NM_025000 |
| Gene Name | Accession |
|-----------|-----------|
| UBE2E1    | NM_182666 |
| ZNF297    | NM_005453 |
| KLHL4     | NM_057162 |
| DTX4      | XM_166213 |
| RNF144    | NM_014746 |
| LOC100134427 | XM_001719136 |
| WWP2      | NM_199424 |
| WDR23     | NM_181357 |
| TAX1BP1   | NM_006024 |
| LOC123103 | NM_001109997 |
| FBXO10    | XM_291314 |
| OIT3      | NM_152635 |
| TBL1X     | NM_005647 |
| UBR2      | NM_015255 |
| OSTM1     | NM_014028 |
| CGI-62    | NM_016010 |
| MARK3     | NM_002376 |
| RWDD1     | NM_013952 |
| LOC554251 | NM_001024680 |
| CBLC      | NM_012116 |
| USP33     | NM_201626 |
| IBTK      | NM_015525 |
| HSPC056   | NM_014154 |
| RFPL2     | NM_006605 |
| GPS1      | NM_004127 |
| NSFL1C    | NM_182483 |
| TEX27     | NM_021943 |
| FBXO24    | NM_012172 |
| LOC652591 | XM_942113 |
| RNF151    | XM_370927 |
| E4F1      | NM_004424 |
| RNF170    | NM_030954 |
| RNF123    | NM_022064 |
| RNF185    | NM_152267 |
| LOC390231 | XM_936301 |
| ZBTB4     | NM_020899 |
| KLHL10    | NM_152467 |
| Ciorf164  | NM_018150 |
| RNF20     | NM_019592 |
| STAM2     | NM_005843 |
| WDR22     | NM_003861 |
| SPSB4     | NM_080862 |
| ANAPC11   | NM_00102245 |
| FBXL3P    | NM_012159 |
| MLL4      | NM_014727 |
| FBXW7     | NM_001013415 |
| FLJ14627  | NM_032814 |
| USP37     | NM_020935 |
| SOCS2     | NM_003877 |
| LOC283116 | XM_001720988 |
| HERC6     | NM_001103000 |
| KIAA0794  | NM_015562 |
| FBXO33    | NM_203301 |
| FBXO16    | NM_172366 |
| ZBTB24    | NM_014797 |
| TRIM6     | NM_058166 |
| C13ORF7   | NM_024546 |
| IKBKG     | NM_003639 |
| FANCL     | NM_018062 |
| USP24     | XM_371254 |
| KCTD2     | NM_015353 |
| TRIP12    | NM_004238 |
| COP5S     | NM_006837 |
| CHFR      | NM_018223 |
| ANAPC4    | NM_013367 |
| TRIML1    | NM_178556 |
| RNF25     | NM_022433 |
| UCHL1     | NM_004181 |
| REV1L     | NM_001037872 |
| UBE2D3    | NM_181893 |
| SPOP      | NM_001007228 |
| MUF1      | NM_006369 |
| KCTD20    | NM_173562 |
| SHKBPI    | NM_138392 |
| UFM1      | NM_016617 |
| PARK2     | NM_013988 |
| TRIP15    | NM_004236 |
| CUL4B     | NM_003588 |
| KCNG3     | NM_172344 |
| TRIM65    | NM_173547 |
| DCST1     | NM_152494 |
| RNF26     | NM_032015 |
| RHOBTB1   | NM_001032380 |
| LOC338692 | NM_207354 |
| TNIP3     | NM_024873 |
| USP4      | NM_199443 |
| ASB1      | NM_016114 |
| ABTB1     | NM_172028 |
| UBE2Z     | NM_023079 |
| TRIM41    | NM_201627 |
| Gene   | Accession   |
|--------|-------------|
| PHF8   | NM_015107   |
| ANAPC13| NM_015391   |
| TRAF2  | NM_021138   |
| CBLB   | NM_170662   |
| TRIM10 | NM_006778   |
| TRIM69 | NM_080745   |
| FBXL5  | NM_012161   |
| LOC643596| XM_926900 |
| ZNF650 | NM_172070   |
| ANAPC5 | NM_016237   |
| GGA1   | NM_001001561|
| RNF152 | NM_173557   |
| PJA2   | NM_014819   |
| KIAA1959| NM_032873  |
| KCND3  | NM_172198   |
| BRAP   | NM_006768   |
| FBXW2  | NM_012164   |
| ZBTB7  | NM_015898   |
| FBXO6  | NM_018438   |
| LOC643596| XM_926900 |
| KBTBD7 | NM_032138   |
| CCIN   | NM_005893   |
| LOC200933| XM_946180  |
| LOC653121| NM_001040441|
| DKFZP761I2123| NM_174929 |
| DUB1A  | XM_377830   |
| TRAF2  | NM_021138   |
| AMFR   | NM_138958   |
| RNF166 | NM_178841   |
| FLJ00012| NM_033388  |
| BCL6B  | NM_181844   |
| TRIM4  | NM_033091   |
| ASB17  | NM_080868   |
| MYCBP2 | NM_015057   |
| ZMYND11| NM_212479   |
| KCNB1  | NM_004975   |
| RNF7   | NM_183237   |
| NFX1   | NM_147133   |
| RKHD2  | NM_016626   |
| C9ORF74| NM_030914   |
| USP36  | NM_025090   |
| C21orf107| NM_001007246|
| LOC124402| NM_145253  |
| DC-UBP | NM_152277   |
| UBE4A  | NM_004788   |
| RNF4   | NM_002938   |
| TRIM61 | NM_001012414|
| LOC646463| XM_929387 |
| ISL1   | NM_002202   |
| LMX1B  | NM_002316   |
| C21orf6| NM_016940   |
| KLHL22 | NM_032775   |
| RNF180 | NM_178532   |
| SMURF2 | NM_022739   |
| UNKL   | NM_001037125|
| RNF5P1 | XM_209913   |
| FBXO7  | NM_001033024|
| LMX1B  | NM_002316   |
| FEM1A  | NM_018708   |
| RNF11  | NM_014372   |
| LONRF3 | NM_024778   |
| RAPSN  | NM_032645   |
| RFPL4B | NM_00103734 |
| RNF5   | NM_006913   |
| PHF2   | NM_024517   |
| FLJ32440| NM_173685  |
| LRSAM1 | NM_00100374 |
| TRIM14 | NM_033219   |
| ZNF238 | NM_205768   |
| LOC339451| NM_198317  |
| ZBTB38 | XM_172341   |
| HSPC063| NM_014155   |
| USP40  | NM_018218   |
| ASB4   | NM_016116   |
| BIRC4  | NM_001167   |
| LOC642446| XM_001732877|
| UBOX5  | NM_199415   |
| MJD    | NM_030660   |
| KCN51  | NM_002251   |
| KCNB2  | NM_004770   |
| DET1   | NM_017996   |
| RNF24  | NM_007219   |
| ZNF288 | NM_015642   |
| FBXO41 | XM_377742   |
| RNF19  | NM_015435   |
| APPBP1 | NM_001018160|
| KBTBD10| NM_006063   |
| COPS3  | NM_003653   |
| LPXN   | NM_004811   |
| FLJ12587| NM_022480  |
| gene   | accession  |
|--------|------------|
| USP51  | NM_201286  |
| ZBTB5  | NM_014872  |
| FBXO40 | NM_016298  |
| ZBTB10 | NM_023929  |
| KCNS2  | NM_020697  |
| RNF113B| NM_178861  |
| RBBP6  | NM_032626  |
| RAD23B | NM_002874  |
| TRIM50A| NM_178125  |
| MEP50  | NM_024102  |
| GAN    | NM_022041  |
| FBXO22 | NM_012170  |
| TRIM48 | NM_024114  |
| NXF1   | NM_006362  |
| TRIM22 | NM_006074  |
| ZNRF4  | NM_181710  |
| M17S2  | NM_005899  |
| NBR1   | NM_031862.4|