**Supplementary Table 4. Pathway analysis of genes coexpressed with proteasome 26S subunit, ATPase 2 (PSMC2) from public breast cancer databases using the MetaCore database (with p<0.01 set as the cutoff value).**

|  |  |  |  |
| --- | --- | --- | --- |
| # | Map | *p* Value | Network objects from active data |
| 1 | Development\_Negative regulation of WNT/Beta-catenin signaling in the cytoplasm | 1.78E-15 | Casein kinase I delta, CXXC4, VHL, DP1, PP1-cat, RIPK4, Presenilin 1, Alpha-1 catenin, Laforin, FAF1, Casein kinase I epsilon, Beta-catenin, CYLD, PI3K cat class III (Vps34), CXXC5, DAB2, Nucleoredoxin, Dsh, YAP1 (YAp65), WWP1, STK4, SIAH1, Ankyrin-G, LATS2, G-protein beta/gamma, Skp2/TrCP/FBXW, TAZ, Axin, RACK1, E-cadherin, LRP5/LRP6, Prickle-1, c-Cbl, HIPK2, STK3, Tcf(Lef), Amer1, beta-TrCP, PR72, JNK1(MAPK8), RNF185, A20, Cul1/Rbx1 E3 ligase, YAP1/TAZ, CDK6, ELAVL1 (HuR), PEG3, Malin, WNT, Beclin 1, NEDD4L, Cyclin D1, NKD2, DACT3, Frizzled, Siah1/SIP/Ebi E3 ligase, DACT1 |
| 2 | Apoptosis and survival\_Regulation of apoptosis by mitochondrial proteins | 1.97E-13 | P53AIP1, p38alpha (MAPK14), Bcl-W, PLSCR3, Calcineurin A (catalytic), MPTP complex, Cathepsin H, Granzyme B, ROCK1, ERK1/2, Parkin, MUL1, BOK, BFL1, HRK, PP2C, VDAC 2, Bak, Cytochrome c, OPA1, NIP3, GZMH, Bax, SOD1, PINK1, PP1-cat alpha, AMBRA1, Mitofusin 1, Caspase-2, Bcl-XL, VDAC 1, Calpain 1(mu), Cathepsin D, Cathepsin L, IFI27, Aif, SMCR7, GC1QBP, PKC-delta, Fis1, HXK1, 14-3-3 zeta/delta, MAP1, Pin1, PARL, Metaxin 1, JSAP1, CDK2, NUR77, ATF-2, SLC25A3, TIMM8A, tBid, Bcl-2, Beclin 1, HtrA2, Cyclin A, JNK(MAPK8-10), Mitofusin 2, DNM1L (DRP1), Calcineurin B (regulatory), Smac/Diablo, p38 MAPK, Bim, Bid |
| 3 | Transcription\_HIF-1 targets | 1.16E-12 | PDK1, PDGF-B, EG-VEGF, PLGF, Oct-3/4, P4HA2, PFKL, REDD1, SLC9A1, Cyclin G2, ENO1, MSH6, Carbonic anhydrase IX, PGK1, Stanniocalcin 2, NIP3, MDR1, AK3, Adipophilin, PLAUR (uPAR), Alpha-1B adrenergic receptor, DEC1 (Stra13), c-Myc, Epo, CXCR4, LRP1, TERT, PKM2, G3P2, Heme oxygenase 1, TGF-beta 2, DEC2, Ceruloplasmin, ROR-alpha, Adrenomedullin, HIF1A, HXK1, GPI, P4HA1, Angiopoietin 2, Thrombospondin 1, TfR1, Mxi1, GLUT1, Carbonic anhydrase XII, MSH2, ALDOA, NUR77, Transferrin, TGF-beta 3, CX3CR1, Galectin-1, MCT4, LDHA, ABCG2, HGF receptor (Met), Leptin, MMP-9, PAI1 |
| 4 | Cytoskeleton remodeling\_Regulation of actin cytoskeleton organization by the kinase effectors of Rho GTPases | 6.94E-12 | WRCH-1, Spectrin, SLC9A1, PRK1, Alpha-actinin, RhoC, LIMK1, Talin, MLCP (reg), Cdc42 subfamily, MSN (moesin), ERM proteins, ARPC1B, RhoA-related, Actin cytoskeletal, MLCK, MLCP (cat), BETA-PIX, RhoA, Citron, RhoJ, F-Actin cytoskeleton, Arp2/3, Myosin II, CPI-17, Alpha adducin, RhoB, PIP5KI, MyHC, LIMK, Rac3, MRCK, RhoGDI alpha, ROCK, DMPK, Actomyosin, Rac1-related, Vinculin, Rhov, MRLC, TC10 |
| 5 | Cell cycle\_Chromosome condensation in prometaphase | 7.91E-11 | TOP1, Cyclin B, CAP-G/G2, CAP-D2/D3, AKAP8, CDK1 (p34), Condensin, TOP2, BRRN1, Histone H3, CAP-G, INCENP, CAP-C, Aurora-A, CAP-E, CAP-H/H2, Cyclin A, CNAP1, Aurora-B, Histone H1 |
| 6 | Development\_Negative regulation of WNT/Beta-catenin signaling in the nucleus | 1.59E-10 | ZNF703, TBL1X, Casein kinase I delta, Calcineurin A (catalytic), RUNX3, HBP1, Oct-3/4, VHL, PGAM5, Alpha-1 catenin, TCF7L2 (TCF4), 14-3-3, Jade-1, Casein kinase I epsilon, Beta-catenin, PAX7, BCL9/B9L, PC1-CTT, TLE, CBP/P300, Dsh, NF-AT5, Nephrocystin-4, HDAC2, HIC1, LATS2, RANBP3, CtBP, PJA2, HIC5, Axin, SOX9, LRP5/LRP6, TRRAP, NARF, c-Cbl, PKC-delta, Tcf(Lef), CDX2, SOX17, GLI-3R, CHD8, Cul1/Rbx1 E3 ligase, NLK, RNF43, WNT, FOXO3A, CHIBBY, HDAC1, Plakoglobin, Frizzled, Histone H1, DACT1 |
| 7 | Immune response\_IFN-alpha/beta signaling via MAPKs | 1.75E-10 | PML, IP10, ISG15, JAK1, Tyk2, TCF7L2 (TCF4), RIG-G, ERK1/2, GCH1, Beta-catenin, Matrilysin (MMP-7), PRMT1, ZNF145, SMAD4, PIAS1, IFN-beta, STAT1, PL scramblase 1, ULK1, IKK-epsilon, Ubiquitin, TAP1 (PSF1), IFN-alpha, ISG54, MEK6(MAP2K6), Axin2, p130, MSK1, RSAD2, FZD7, Lck, PKR, PKC-delta, IRF9, JNK1(MAPK8), MEK4(MAP2K4), MEKK1(MAP3K1), SP5, Filamin B (TABP), FOXO3A, FasR(CD95), Cyclin D1, JNK(MAPK8-10), HDAC1, SMAD3, p38 MAPK |
| 8 | Immune response\_IL-4-induced regulators of cell growth, survival, differentiation and metabolism | 1.9E-10 | ATP6V1B2, DHA2, MCM5, IL-4R type I, SOCS1, CDC25A, Cytochrome c, ATP6V0A1, STAT1, CPT-1A, Filaggrin, EGR2 (Krox20), Bax, CISH, CDK4, Bcl-XL, ACADM, FasL(TNFSF6), c-Myc, GATA-3, A-FABP, MMP-13, PLEKHF1, MCM4, IL-4R type II, Cyclin D, CYP2E1, IL4RA, Bcl-6, SK4/IK1, Cathepsin V, CDK2, CDK6, Cyclin E, HSD3B1, Bcl-2, FOXO3A, MCM6, STAT5, Cyclin A, STAT6 |
| 9 | Transcription\_Negative regulation of HIF1A function | 2.47E-10 | p14ARF, Casein kinase I delta, MCM5, RUNX3, VHL, COMMD1 (MURR1), FBXW7, SART1, KLF2, VCP, SKP1, UBXD7, Ubiquitin, ING4, EGLN2, MCM7, LAMP2, EAF2, HSP40, MCM2, HSP90, Calpain 1(mu), HSP70, HSPA4, EGLN1, RACK1, MCM3, DEC2, HSC70, HIF1A, ARD1, PSMA7, Sirtuin2, HSP90 beta, Cul1/Rbx1 E3 ligase, AML1 (RUNX1), FHL1 (SLIM1), PTEN, Sirtuin7, SSAT, Elongin C, HIF-prolyl hydroxylase, Proteasome (20S core), PRDX4 |
| 10 | Development\_Positive regulation of WNT/Beta-catenin signaling in the nucleus | 2.47E-10 | Casein kinase II, alpha chains, SMYD2, TBL1X, CBP, DP1, Alpha-1 catenin, TCF7L2 (TCF4), FOXP1, Jade-1, Beta-catenin, BCL9/B9L, VCP, TLE, CBP/P300, Dsh, YAP1 (YAp65), HDAC2, UCHL5, PCAF, RUNX, SOX9, TERT, JRK, SOX11, LRP5/LRP6, TWA1, Tcf(Lef), PIAS4, beta-TrCP, FOXM1, Pin1, p300, NCOA2 (GRIP1/TIF2), TDG, Cul1/Rbx1 E3 ligase, NLK, CARF, WNT, FOXO3A, HMGB2, HDAC1, APPL, LRRFIP2, Frizzled |
| 11 | Immune response\_HSP60 and HSP70/ TLR signaling pathway | 3.12E-10 | MHC class II, ERK1/2, MD-2, E2N(UBC13), IKK (cat), IL-12 alpha, Ubiquitin, IL-1 beta, I-kB, CD14, MyD88, IKK-alpha, MEK6(MAP2K6), MHC class I, MEK1/2, TPL2(MAP3K8), CD83, NF-kB, HSP60, UEV1A, HSP70, TNF-alpha, CD80, NF-kB1 (p105), IL-8, TRAF6, TIRAP (Mal), TAB3, MEK4(MAP2K4), UBE1, IKK-beta, TAB1, IRAK1/2, JNK(MAPK8-10), CD40(TNFRSF5), p38 MAPK, CD86 |
| 12 | Oxidative stress\_ROS-induced cellular signaling | 5.02E-10 | Casein kinase II, alpha chains, p38alpha (MAPK14), Tuberin, SREBP1 (nuclear), ERK1/2, EGR1, IKK (cat), Bak, Cytochrome c, FASN, Carbonic anhydrase IX, IL-1 beta, Bax, FTL, IKK-alpha, FTH1, IRP2, GRP75, NF-kB, Cyclin B1, TNF-alpha, Thioredoxin, Heme oxygenase 1, Chk2, Adrenomedullin, HIF1A, IL-8, SRX1, Pin1, NIK(MAP3K14), Glutaredoxin 1, p300, JNK1(MAPK8), HSPA1A, GSTP1, TfR1, ELAVL1 (HuR), HSF1, NOTCH3 (3ICD), PRKD1, GPX1, PKC, LKB1, PTEN, MEKK1(MAP3K1), HES1, HSP27, IKK-beta, DLC1 (Dynein LC8a), c-Abl, Cyclin D1, JNK(MAPK8-10), HIF-prolyl hydroxylase, HDAC1, SAE2, SP1, NRF2, p38 MAPK, APEX, PAI1 |
| 13 | Immune response\_IFN-alpha/beta signaling via PI3K and NF-kB pathways | 6.96E-10 | Tuberin, Cyclin D3, ISG15, JAK1, IRS-2, Tyk2, IRS-1, DHFR, NMI, ERK1/2, IKK (cat), CDC25A, PKC-epsilon, IFN-beta, CDK1 (p34), I-kB, p70 S6 kinases, PI3K reg class IA (p85), Rb protein, CDK4, IKK-alpha, IFN-alpha, p19, ISG54, CREB1, p130, MEK1/2, RSAD2, NF-kB, PDK (PDPK1), p16INK4, p107, c-Myc, PU.1, pRB/E2F4, PKC-delta, I-TAC, PDCD4, p130/E2F4, p107/E2F4, eIF4B, eIF4G1/3, NIK(MAP3K14), CDK2, PCNA, 4E-BP1, GBP1, IFIT1, E2F4, Cyclin E, eIF4A, FOXO3A, MNK2(GPRK7), Cyclin A |
| 14 | Glomerular injury in Lupus Nephritis | 8.69E-10 | GRO-2, PDGF-B, IP10, HMGB1, CCL2, NGAL, H-Ras, C5a, IFN-gamma, ERK1/2, ATF-4, IRF1, PKC-epsilon, IFN-beta, FN14(TNFRSF12A), STAT1, CCL5, IL-1 beta, Bax, GRO-1, ErbB2, MDA-5, IFN-alpha, GM-CSF, MEK1/2, FasL(TNFSF6), NF-kB, RIG-I, PDK (PDPK1), IFI56, TNF-alpha, C5aR, Otubain1, VCAM1, p22-phox, HIF1A, MMP-1, IL-8, TRAF6, TGF-beta, SLC22A17, PDGF-AB, A20, Annexin II, Bcl-2, FasR(CD95), Cyclin D1, JNK(MAPK8-10), MIP-1-alpha, TLR3, p38 MAPK, MMP-9, PDGF-R-beta |
| 15 | DNA damage\_p53 activation by DNA damage | 1.14E-09 | P53AIP1, p38alpha (MAPK14), CBP, PML, 14-3-3, PP2A regulatory, P53DINP1a, 14-3-3 theta, Tip60, Chk1, Bax, TTC5 (Strap), PCAF, PP2A structural, MEK6(MAP2K6), Bcl-XL, FBXO31, DBC1, RFWD3, Chk2, Brca1, SMG1, HIPK2, PKC-delta, CABIN1, DDB1, AATF (Che-1), MARKK, p300, DYRK2, MEK4(MAP2K4), ELAVL1 (HuR), MEKK1(MAP3K1), Bcl-2, c-Abl, COP1, JNK(MAPK8-10), p38 MAPK, PP2C gamma |
| 16 | Cell cycle\_Cell cycle (generic schema) | 2.16E-09 | Cyclin B, E2F5, DP1, CDC25A, E2F3, CDK1 (p34), Rb protein, E2F2, CDK4, p130, p107, CDC25C, CDC25B, Cyclin D, CDK2, CDK6, E2F4, Cyclin E, Cyclin A |
| 17 | Epigenetic alterations in ovarian cancer | 2.59E-09 | DNMT3B, TIMP3, ESR1 (nuclear), ZIC4, CDC20, HRK, DAB2, WIF1, FGFR1, GLI-2, Bax, ErbB2, HDAC2, CDK4, Vasohibin-1, CARD5, IGF-2, AL1A1, EZH2, SKP2, TWIST1, HSD3B2, p16INK4, E-cadherin, FGFR3, Brca1, Histone H3, DAPK1, SF1, ErbB4, DNMT3A, Thrombospondin 1, Aurora-A, DOK2, CYP11A1, CDK6, GSTP1, Gamma-synuclein, Dlec1, Claudin-4, SSTR1, Aurora-B, HDAC1, BLU, GLI-1, DACT3, MMP-9, Thrombospondin 2 |
| 18 | Role of IGH translocations in multiple myeloma | 3.35E-09 | alpha-E/beta-7 integrin, NCAM1, Cyclin D3, CCR1, Cyclin D2, Rb protein, HDAC2, MafB, CDK4, ITGB7, p130, ITGAE, p107, c-Myc, E-cadherin, FGFR3, Histone H3, Sin3A, IRF4, NOTCH2, CDK6, c-Maf, E2F4, HES1, RhoE, Cyclin D1, HDAC1, MRF-1, Histone H4 |
| 19 | Proteolysis\_Putative ubiquitin pathway | 3.67E-09 | FBXW7, UBCH7, Parkin, E2N(UBC13), UBCH8, SKP1, Ubiquitin, UBCH6, UBE2D1, SKP2, UEV1A, HSP70, GPR37, TRAF6, Cul1/Rbx1 E3 ligase, Cullin 1, UBE1, MJD (ataxin-3), RING-box protein 1, Synphilin 1 |
| 20 | Coronavirus disease-19 | 6.21E-09 | GRO-2, MIG, MHC class II, IP10, ISG15, ECSIT, CCL2, Tyk2, NKG2A, IFN-gamma, ERK1/2, TBK1, MSK1/2 (RPS6KA5/4), IKK (cat), VISA, TBKBP1(SINTBAD), Angiotensin II, IFN-beta, STAT1, CCL5, IL-1 beta, I-kB, HDAC2, MyD88, MDA-5, IFN-alpha, CCL8, cPLA2, MEK6(MAP2K6), SRP19, Casein kinase II, CREB1, MHC class I, NF-kB, Eotaxin, RIG-I, ACE2, IL29, TNF-alpha, Cathepsin L, Casein kinase II, beta chain (Phosvitin), JAK2, sIL2RA, IL28B, TRAF3, IL-8, PIP5KIII, AGTR1, eIF4H, SRP54, G3BP1 (hdhVIII), SRP72, CXCL16, TRIM59, Casein kinase II, alpha' chain (CSNK2A2), CCL7, TMPRSS4, NRDP1, TOM70, CD8, CD3, SP1, MIP-1-alpha, TLR3, 4EHP, RAE1, p38 MAPK, PAI1 |
| 21 | Cell cycle\_Role of SCF complex in cell cycle regulation | 7.96E-09 | NEDD8, CDC25A, SKP1, CDK1 (p34), Ubiquitin, Chk1, Wee1, CKS1, CDK4, p130, Skp2/TrCP/FBXW, SKP2, Emi1, PLK1, beta-TrCP, Cul1/Rbx1 E3 ligase, CDK2, Cullin 1, UBE1, Cyclin E, Cyclin D1, RING-box protein 1, SMAD3 |
| 22 | Role of activation of WNT signaling in the progression of lung cancer | 8.71E-09 | RUNX3, Oct-3/4, Krm1, TCF7L2 (TCF4), DKK1, FZD8, Beta-catenin, Matrilysin (MMP-7), Dsh, WIF1, ING4, FZD2, Survivin, DKK3, Axin2, EZH2, SKP2, FZD9, c-Myc, FZD7, DVL-2, Axin, CD147, RUVBL1, WNT4, E-cadherin, ROR2, Livin, Tcf(Lef), beta-TrCP, WNT3, ARD1, MKK7 (MAP2K7), JNK1(MAPK8), SFRP5, LKB1, MEKK1(MAP3K1), WNT, FZD5, LRP6, Cyclin D1, HOXB9, p38 MAPK, Frizzled, NOTCH3 |
| 23 | Regulation of degradation of deltaF508-CFTR in CF | 8.99E-09 | NPL4, VCP, HDAC6, Sti1, Ubiquitin, Csp, UBE2D1, HSP90, HSP70, RNF5, SEC61 complex, UFD1, HSC70, Dynein 1, cytoplasmic, light chains, HSP105, Hdj-2, SAE1, SUMO-3, USP19, UBE1, Aha1, SUMO-2, HSP27, UCHL1, AMFR, MJD (ataxin-3), Proteasome (20S core), Derlin1 |
| 24 | NRF2 regulation of oxidative stress response | 9.08E-09 | Casein kinase II, alpha chains, CBP, NRF1, GSHB, CRM1, SMRT, SLC7A11, GSTM3, Ubiquitin, UGT1A1, SOD1, PI3K reg class IA, RARalpha, Actin cytoskeletal, Fyn, GSTA3, MafF, PDK (PDPK1), ERK1 (MAPK3), MEK1(MAP2K1), Casein kinase II, beta chain (Phosvitin), Thioredoxin, Heme oxygenase 1, GCL reg, DJ-1, GSTA2, PRDX1, JNK1(MAPK8), MEK4(MAP2K4), GSTP1, PKC, GSTA1, TXNRD1, NRF2, NQO1 |
| 25 | Cell cycle\_Spindle assembly and chromosome separation | 9.33E-09 | DCTN2, Cyclin B, Separase, Nek2A, CDC20, MAD2a, Importin (karyopherin)-alpha, RCC1, Kid, CSE1L, CDK1 (p34), Ubiquitin, TPX2, Ran, Tubulin (in microtubules), Importin (karyopherin)-beta, NUMA1, ZW10, Dynein 1, cytoplasmic, light chains, Aurora-A, Securin, Tubulin alpha, KNSL1, Aurora-B, HEC |
| 26 | Cell cycle\_ESR1 regulation of G1/S transition | 9.49E-09 | CRM1, c-Fos, ESR1 (nuclear), ERK1/2, CDC25A, Ubiquitin, Rb protein, CKS1, CDK4, Cyclin A2, p130, Skp2/TrCP/FBXW, SKP2, c-Myc, NCOA3 (pCIP/SRC3), Cul1/Rbx1 E3 ligase, CDK2, CDK6, Cullin 1, E2F4/DP1 complex, CARM1, E2F4, Cyclin E, Cyclin A, Cyclin D1, SP1 |
| 27 | Immune response\_IL-3 signaling via JAK/STAT, p38, JNK and NF-kB | 1.78E-08 | MHC class II, DHA2, Cyclin D3, c-Fos, JAK1, Tyk2, XBP1, Granzyme B, H-Ras, SOCS1, IKK (cat), Pim-1, STAT1, Cyclin D2, I-kB, CISH, SRP9, Survivin, Cyclin A2, IKK-alpha, RARalpha, Bcl-XL, NF-kB, IRE1, Cyclin B1, c-Myc, IL-2R alpha chain, PKM2, PU.1, JAK2, C/EBPbeta, Lyn, TRAF6, RXRA, 14-3-3 gamma, RAR-alpha/RXR-alpha, Bcl-6, MKK7 (MAP2K7), JNK1(MAPK8), JAK3, MEK4(MAP2K4), IKK-beta, Bcl-2, KSR1, Oncostatin M, STAT5, Cyclin D1, HDAC1, CD40(TNFRSF5), STAT6, p38 MAPK |
| 28 | DNA damage\_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling | 2.57E-08 | p38alpha (MAPK14), BORA, PP1-cat, 14-3-3, PP2A regulatory, CDC25A, Nek11, CDK1 (p34), MLCP (reg), TAO2, Chk1, MEK6(MAP2K6), Cyclin B1, PLK1, MLCP (cat), Chk2, Brca1, Histone H3, CDC25C, beta-TrCP, CDC25B, JAB1, 14-3-3 gamma, MARKK, Aurora-A, Cul1/Rbx1 E3 ligase, MEK4(MAP2K4), UBE2C, MEKK1(MAP3K1), FOXO3A, c-Abl, Aurora-B, p38 MAPK |
| 29 | Signal transduction\_Calcium-mediated signaling | 2.93E-08 | Calcineurin A (catalytic), c-Fos, ERK1/2, 14-3-3, CaMK I, EGR1, HDAC4, MUNC13, p47-phox, IP3 receptor, MLCP (reg), I-kB, PPA5, MEK6(MAP2K6), CREB1, NF-kB, Calcitonin receptor, MLCP (cat), RhoA, Tiam1, Myocardin, CABIN1, Myosin II, MEF2, HDAC5, p300, RhoGDI alpha, MEK4(MAP2K4), PPCKC, ROCK, Calmodulin, PKC, NUR77, MYH11, ATF-2, CaMKK, IKK-beta, JNK(MAPK8-10), NURR1, p38 MAPK, MMP-9, CaMKK2 |
| 30 | Transcription\_Sin3 and NuRD in transcription regulation | 5.17E-08 | TR-alpha, SMRT, SAP130, ARID4A, MBD2, HDAC2, Mi-2 beta, NRSF, RARalpha, Mi-2 alpha, N-CoR, ARID4B, p66beta, PSF, RAR-alpha/TR-alpha, Mi-2, Histone H3, Sin3A, RXRA, RAR-alpha/RXR-alpha, MTA2, RBBP7 (RbAp46), Sin3B, HDAC1, SAP30, NRB54, p66alpha, Histone H4 |