

SEQUENCE LISTING

<110> Pharmexa A/S

<120> IMMUNOGENIC ANALOGUES OF RANKL

<130> 16851PCT00

<160> 146

<170> PatentIn version 3.5

<210> 1

<211> 177

<212> PRT

<213> Homo sapiens

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Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys
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Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ala
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Ala Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Leu Tyr Ala Asn Ile
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Ile Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Asp Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 2
 <211> 316
 <212> PRT
 <213> Homo sapiens

<400> 2

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Pro Pro Pro Ala Pro His Gln Pro Pro Ala Ala Ser Arg Ser Met Phe
 35 40 45

Val Ala Leu Leu Gly Leu Gly Leu Gly Gln Val Val Cys Ser Val Ala
 50 55 60

Leu Phe Phe Tyr Phe Arg Ala Gln Met Asp Pro Asn Arg Ile Ser Glu
 65 70 75 80

Asp Gly Thr His Cys Ile Tyr Arg Ile Leu Arg Leu His Glu Asn Ala
 85 90 95

Asp Phe Gln Asp Thr Thr Leu Glu Ser Gln Asp Thr Lys Leu Ile Pro
 100 105 110

Asp Ser Cys Arg Arg Ile Lys Gln Ala Phe Gln Gly Ala Val Gln Lys
 115 120 125

Glu Leu Gln His Ile Val Gly Ser Gln His Ile Arg Ala Glu Lys Ala
 130 135 140

Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys Arg Ser Lys Leu Glu
 145 150 155 160

Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ala Thr Asp Ile Pro Ser
 165 170 175

Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp Arg Gly Trp
 180 185 190

Ala Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys Leu Ile Val Asn
 195 200 205

Gln Asp Gly Phe Tyr Tyr Leu Tyr Ala Asn Ile Cys Phe Arg His His
 210 215 220

Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu Met Val Tyr
 225 230 235 240

Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His Thr Leu Met Lys
 245 250 255

Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu Phe His Phe Tyr
 260 265 270

Ser Ile Asn Val Gly Gly Phe Phe Lys Leu Arg Ser Gly Glu Glu Ile
 275 280 285

Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro Asp Gln Asp Ala
 290 295 300

Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 305 310 315

<210> 3

<211> 534

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<223> Codon optimised and mutated DNA sequence encoding mutated hRANKL

<220>

<221> CDS

<222> (1)..(534)

<220>

<221> mutation

<222> (94)..(96)

<223> Nucleotides encoding Ala to Ser mutation

<220>

<221> mutation

<222> (160)..(162)

<223> Nucleotides encoding Ala to Gly mutation

<220>
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 <222> (226)..(228)
 <223> Nucleotides encoding Leu to Ile mutation

<220>
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 <222> (238)..(240)
 <223> Nucleotides encoding Ile to Val mutation

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 <222> (403)..(405)
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 1 5 10 15
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 Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30
 acc gat atc cca agc ggt agt cat aag gtt tcc ttg tca agc tgg tat 144
 Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45
 cat gat cgc ggc tgg ggc aag att tca aat atg acc ttc agc aat ggc 192
 His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60
 aag ttg att gtc aat caa gac ggc ttt tat tat att tat gcg aac gtc 240
 Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80
 tgc ttt cgc cac cac gag act tcc ggt gat ctt gca acc gag tac ctg 288
 Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95
 caa ctt atg gtc tac gtg act aag acc tcc att aag atc ccg tca tcc 336
 Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110
 cat acc ttg atg aag ggt ggg tcg act aag tac tgg agt ggc aat tcc 384
 His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125
 gag ttt cat ttc tac agc gtg aat gtg ggt ggc ttt ttt aag ctt cgg 432
 Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

agc ggc gag gag atc tcc atc gag gtt agt aat ccc agc ctg ctg gat 480
 Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

ccc gag cag gat gcc acc tac ttc ggt gcc ttc aaa gtt cgc gat att 528
 Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

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 Asp

<210> 4
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Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys
 1 5 10 15

Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 5
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 <223> Synthetic pan DR binding peptide (PADRE)

<220>
 <221> CDS
 <222> (1)..(39)

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 Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala
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<210> 6
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<400> 6

Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala
 1 5 10

<210> 7
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<220>
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gccggcgaac gtggcgagaa agg 23

<210> 9
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cctgcgttat cccctgattc tgtg 24

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<400> 10
tattatctgt attccaacat ctgcttt 27

<210> 11
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aaagcagatg ttggaataca gataata 27

<210> 12
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tattatctgt atggcaacat ctgcttt 27

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aaagcagatg ttgccataca gataata 27

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tatctgtatg cgcagatctg ctttcgc 27

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<210> 17
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<210> 18
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<400> 18
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 ggcaag 66

<210> 20
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 ggctcag 66

<210> 21
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<400> 21
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<210> 22
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<210> 26
<211> 62
<212> DNA
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<210> 27
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<212> DNA
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<210> 28
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<400> 28
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<400> 29
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<210> 30
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<210> 38
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<210> 49
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cccgagcgag aggccaacaa aggccac 27

<210> 53
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<210> 54
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 <210> 58
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 <400> 58
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<210> 62
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<400> 62
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 cc 62

<210> 63
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 <212> DNA
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<220>
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<400> 63
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<210> 64
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 tagc 64

<210> 65
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<400> 65
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<210> 67

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<400> 67
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c 61

<210> 68

<211> 62

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<400> 68
gttcgtggcc gcttggaccc tgaaggccgc agctcgctcc aagttggagg cccaaccatt 60

tg 62

<210> 69

<211> 60

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c 61

<210> 71
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c 61

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c 61

<210> 73
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ggccttcagg gtccaagcgg ccacgaactt ggcttgatgt tgatgttgat gttgatgttg 60

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ggccttcagg gtccaagcgg ccacgaactt ggctttctcg gcacgttgat gttgatgttg 60

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<212> DNA

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<210> 77

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ctaccatcca ccatggcttt ctccggcacgt tgatgttgat gttgatgttg atgttg 56

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<211> 52
<212> DNA
<213> Artificial sequence

<220>
<223> Synthetic primer

<400> 80
gtggcctttg ttggcctctc gctcggggag aaagccatgg tggatggtag cg 52

<210> 81
<211> 54
<212> DNA
<213> Artificial sequence

<220>
<223> Synthetic primer

<400> 81
gtggcctttg ttggcctctc gctcggggag aaagccatgg tggatgccaa gttc 54

<210> 82
<211> 53
<212> DNA
<213> Artificial sequence

<220>
<223> Synthetic primer

<400> 82
gtggcctttg ttggcctctc gctcggggag aaagccatgg tggatggtag ctg 53

<210> 83
<211> 53
<212> DNA
<213> Artificial sequence

<220>
<223> Synthetic primer

<400> 83
gtggcctttg ttggcctctc gctcggggag aaagccatgg tggatggtag ttg 53

<210> 84
<211> 23
<212> DNA
<213> Artificial sequence

<220>

<223> Synthetic primer

<400> 84

ggccttttgc tggccttttg ctc

23

<210> 85

<211> 34

<212> PRT

<213> Homo sapiens

<400> 85

Arg	Ser	Gly	Glu	Glu	Ile	Ser	Ile	Glu	Val	Ser	Asn	Pro	Ser	Leu	Leu
1				5					10					15	

Asp	Pro	Asp	Gln	Asp	Ala	Thr	Tyr	Phe	Gly	Ala	Phe	Lys	Val	Arg	Asp
			20					25					30		

Ile Asp

<210> 86

<211> 46

<212> PRT

<213> Artificial sequence

<220>

<223> Mofified RANKL loop 1

<400> 86

Arg	Ser	Gly	Glu	Glu	Ile	Ser	Ile	Glu	Val	Ser	Asn	Pro	Ala	Lys	Phe
1				5					10					15	

Val	Ala	Ala	Trp	Thr	Leu	Lys	Ala	Ala	Ala	Leu	Leu	Asp	Pro	Asp	Gln
			20				25						30		

Asp	Ala	Thr	Tyr	Phe	Gly	Ala	Phe	Lys	Val	Arg	Asp	Ile	Asp
			35				40					45	

<210> 87

<211> 26

<212> PRT

<213> Homo sapiens

<400> 87

Tyr	Leu	Gln	Leu	Met	Val	Tyr	Val	Thr	Lys	Thr	Ser	Ile	Lys	Ile	Pro
1				5					10					15	

Ser Ser His Thr Leu Met Lys Gly Gly Ser
20 25

<210> 88
<211> 37
<212> PRT
<213> Artificial sequence

<220>
<223> DE loop variant

<400> 88

Tyr Leu Gln Leu Met Val Tyr Val Ala Lys Phe Val Ala Ala Trp Thr
1 5 10 15

Leu Lys Ala Ala Ala Thr Ser Ile Lys Ile Pro Ser Ser His Thr Leu
20 25 30

Met Lys Gly Gly Ser
35

<210> 89
<211> 37
<212> PRT
<213> Artificial sequence

<220>
<223> DE Loop variant

<400> 89

Tyr Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Ala Lys Phe
1 5 10 15

Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Pro Ser Ser His Thr Leu
20 25 30

Met Lys Gly Gly Ser
35

<210> 90
<211> 36
<212> PRT
<213> Artificial sequence

<220>
<223> DE Loop variant

<400> 90

Tyr Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ala Lys Phe Val
 1 5 10 15

Ala Ala Trp Thr Leu Lys Ala Ala Ala Pro Ser Ser His Thr Leu Met
 20 25 30

Lys Gly Gly Ser
 35

<210> 91
 <211> 33
 <212> PRT
 <213> Homo sapiens

<400> 91

Pro Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser
 1 5 10 15

Gly Asn Ser Glu Phe His Phe Tyr Ser Ile Asn Val Gly Gly Phe Phe
 20 25 30

Lys

<210> 92
 <211> 44
 <212> PRT
 <213> Artificial sequence

<220>
 <223> EF Loop variant

<400> 92

Pro Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser
 1 5 10 15

Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Ser Glu Phe
 20 25 30

His Phe Tyr Ser Ile Asn Val Gly Gly Phe Phe Lys
 35 40

<210> 93
 <211> 43
 <212> PRT
 <213> Artificial sequence

<220>

<223> EF Loop variant

<400> 93

Pro Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ala
1 5 10 15

Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Ser Glu Phe His
20 25 30

Phe Tyr Ser Ile Asn Val Gly Gly Phe Phe Lys
35 40

<210> 94

<211> 45

<212> PRT

<213> Artificial sequence

<220>

<223> EF Loop variant

<400> 94

Pro Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser
1 5 10 15

Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Asn Ser Glu
20 25 30

Phe His Phe Tyr Ser Ile Asn Val Gly Gly Phe Phe Lys
35 40 45

<210> 95

<211> 24

<212> PRT

<213> Homo sapiens

<400> 95

Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr
1 5 10 15

Leu Gln Leu Met Val Tyr Val Thr
20

<210> 96

<211> 36

<212> PRT

<213> Artificial sequence

<220>

<223> CD Loop variant

<400> 96

Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Lys Phe Val
1 5 10 15

Ala Ala Trp Thr Leu Lys Ala Ala Ala Thr Glu Tyr Leu Gln Leu Met
20 25 30

Val Tyr Val Thr
35

<210> 97

<211> 36

<212> PRT

<213> Artificial sequence

<220>

<223> CD Loop variant

<400> 97

Val Cys Phe Arg His His Glu Thr Ser Gly Asp Ala Lys Phe Val Ala
1 5 10 15

Ala Trp Thr Leu Lys Ala Ala Ala Ala Thr Glu Tyr Leu Gln Leu Met
20 25 30

Val Tyr Val Thr
35

<210> 98

<211> 36

<212> PRT

<213> Artificial sequence

<220>

<223> CD Loop variant

<400> 98

Val Cys Phe Arg His His Glu Thr Ser Ala Lys Phe Val Ala Ala Trp
1 5 10 15

Thr Leu Lys Ala Ala Ala Asp Leu Ala Thr Glu Tyr Leu Gln Leu Met
20 25 30

Val Tyr Val Thr
35

<210> 99
 <211> 36
 <212> PRT
 <213> Artificial sequence

<220>
 <223> CD Loop variant

<400> 99

Val Cys Phe Arg His His Glu Thr Ala Lys Phe Val Ala Ala Trp Thr
 1 5 10 15

Leu Lys Ala Ala Ala Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu Met
 20 25 30

Val Tyr Val Thr
 35

<210> 100
 <211> 36
 <212> PRT
 <213> Artificial sequence

<220>
 <223> CD Loop variant

<400> 100

Val Cys Phe Arg His His Glu Thr Ser Gly Ala Lys Phe Val Ala Ala
 1 5 10 15

Trp Thr Leu Lys Ala Ala Ala Leu Ala Thr Glu Tyr Leu Gln Leu Met
 20 25 30

Val Tyr Val Thr
 35

<210> 101
 <211> 59
 <212> PRT
 <213> Homo sapiens

<400> 101

Met Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala
 1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
 20 25 30

Ala Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp
 35 40 45

Tyr His Asp Arg Gly Trp Ala Lys Ile Ser Asn
 50 55

<210> 102
 <211> 62
 <212> PRT
 <213> Artificial sequence

<220>
 <223> AA" Loop variant

<400> 102

Met Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala
 1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
 20 25 30

Ala Thr Asp Ile Pro Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala
 35 40 45

Ala Ala Trp Tyr His Asp Arg Gly Trp Ala Lys Ile Ser Asn
 50 55 60

<210> 103
 <211> 67
 <212> PRT
 <213> Artificial sequence

<220>
 <223> AA" Loop variant

<400> 103

Met Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala
 1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
 20 25 30

Ala Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Gly Ser
 35 40 45

His Lys Val Ser Leu Ser Ser Trp Tyr His Asp Arg Gly Trp Ala Lys
 50 55 60

Ile Ser Asn
65

<210> 104
<211> 60
<212> PRT
<213> Artificial sequence

<220>
<223> AA" Loop variant

<400> 104

Met Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala
1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
20 25 30

Ala Thr Asp Ile Pro Ser Gly Ser His Ala Lys Phe Val Ala Ala Trp
35 40 45

Thr Leu Lys Ala Ala Ala Trp Ala Lys Ile Ser Asn
50 55 60

<210> 105
<211> 72
<212> PRT
<213> Artificial sequence

<220>
<223> AA" Loop variant

<400> 105

Met Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala
1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
20 25 30

Ala Thr Asp Ile Pro Ser Ala Lys Phe Val Ala Ala Trp Thr Leu Lys
35 40 45

Ala Ala Ala Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp
50 55 60

Arg Gly Trp Ala Lys Ile Ser Asn
65 70

<210> 106
<211> 59
<212> PRT
<213> Artificial sequence

<220>
<223> AA" Loop variant

<400> 106

Met Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala
1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
20 25 30

Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Ser Ser Trp
35 40 45

Tyr His Asp Arg Gly Trp Ala Lys Ile Ser Asn
50 55

<210> 107
<211> 23
<212> PRT
<213> Homo sapiens

<400> 107

Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys
1 5 10 15

Arg Ser Lys Leu Glu Ala Gln
20

<210> 108
<211> 25
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 108

Arg Ala Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
1 5 10 15

Ala Lys Arg Ser Lys Leu Glu Ala Gln
20 25

<210> 109
<211> 22
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 109

Arg Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Lys Arg
1 5 10 15

Ser Lys Leu Glu Ala Gln
20

<210> 110
<211> 22
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 110

Arg Ala Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
1 5 10 15

Ala Lys Leu Glu Ala Gln
20

<210> 111
<211> 23
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 111

Arg Ala Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
1 5 10 15

Ala Ser Lys Leu Glu Ala Gln
20

<210> 112

<211> 28
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 112

Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys
1 5 10 15

Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Gln
20 25

<210> 113
<211> 24
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 113

Arg Ala Glu Lys Ala Met Ala Lys Phe Val Ala Ala Trp Thr Leu Lys
1 5 10 15

Ala Ala Ala Lys Leu Glu Ala Gln
20

<210> 114
<211> 24
<212> PRT
<213> Artificial sequence

<220>
<223> Stalk variant

<400> 114

Arg Ala Glu Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala
1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln
20

<210> 115
<211> 23
<212> PRT
<213> Artificial sequence

<220>

<223> Stalk variant

<400> 115

Arg Ala Glu Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala
1 5 10 15

Arg Ser Lys Leu Glu Ala Gln
20

<210> 116

<211> 23

<212> PRT

<213> Artificial sequence

<220>

<223> Stalk variant

<400> 116

Arg Ala Glu Lys Ala Met Val Asp Gly Ala Lys Phe Val Ala Ala Trp
1 5 10 15

Thr Leu Lys Ala Ala Ala Gln
20

<210> 117

<211> 24

<212> PRT

<213> Artificial sequence

<220>

<223> Stalk variant

<400> 117

Arg Ala Glu Lys Ala Met Val Asp Gly Ser Ala Lys Phe Val Ala Ala
1 5 10 15

Trp Thr Leu Lys Ala Ala Ala Gln
20

<210> 118

<211> 22

<212> PRT

<213> Artificial sequence

<220>

<223> Stalk variant

<400> 118

Arg Ala Glu Lys Ala Met Val Asp Ala Lys Phe Val Ala Ala Trp Thr
 1 5 10 15

Leu Lys Ala Ala Ala Gln
 20

<210> 119
 <211> 23
 <212> PRT
 <213> Artificial sequence

<220>
 <223> Stalk variant

<400> 119

Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Leu Ala Lys
 1 5 10 15

Arg Ser Lys Leu Glu Ala Gln
 20

<210> 120
 <211> 179
 <212> PRT
 <213> Artificial sequence

<220>
 <223> Immunogenic RANKL variant with PADRE in stalk region

<400> 120

Arg Ala Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
 1 5 10 15

Ala Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile
 20 25 30

Asn Ser Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser
 35 40 45

Trp Tyr His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser
 50 55 60

Asn Gly Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala
 65 70 75 80

Asn Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu
 85 90 95

Tyr Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro
 100 105 110

Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly
 115 120 125

Asn Ser Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys
 130 135 140

Leu Arg Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu
 145 150 155 160

Leu Asp Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg
 165 170 175

Asp Ile Asp

<210> 121

<211> 176

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 121

Arg Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Lys Arg
 1 5 10 15

Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr
 20 25 30

Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His
 35 40 45

Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys
 50 55 60

Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys
 65 70 75 80

Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln
 85 90 95

Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His
 100 105 110

Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu
 115 120 125

Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser
 130 135 140

Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro
 145 150 155 160

Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170 175

<210> 122

<211> 176

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 122

Arg Ala Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
 1 5 10 15

Ala Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr
 20 25 30

Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His
 35 40 45

Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys
 50 55 60

Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys
 65 70 75 80

Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln
 85 90 95

Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His
 100 105 110

Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu
 115 120 125

Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser
 130 135 140

Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro
 145 150 155 160

Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170 175

<210> 123

<211> 177

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 123

Arg Ala Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
 1 5 10 15

Ala Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 124

<211> 182

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 124

Arg Ala Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys
 1 5 10 15

Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Gln Pro Phe Ala His
 20 25 30

Leu Thr Ile Asn Ser Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser
 35 40 45

Leu Ser Ser Trp Tyr His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met
 50 55 60

Thr Phe Ser Asn Gly Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr
 65 70 75 80

Ile Tyr Ala Asn Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu
 85 90 95

Ala Thr Glu Tyr Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile
 100 105 110

Lys Ile Pro Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr
 115 120 125

Trp Ser Gly Asn Ser Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly
 130 135 140

Phe Phe Lys Leu Arg Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn
 145 150 155 160

Pro Ser Leu Leu Asp Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe
 165 170 175

Lys Val Arg Asp Ile Asp
 180

<210> 125

<211> 178

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 125

Arg Ala Glu Lys Ala Met Ala Lys Phe Val Ala Ala Trp Thr Leu Lys
 1 5 10 15

Ala Ala Ala Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
 20 25 30

Ser Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp
 35 40 45

Tyr His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn
 50 55 60

Gly Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn
 65 70 75 80

Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr
 85 90 95

Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser
 100 105 110

Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn
 115 120 125

Ser Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu
 130 135 140

Arg Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu
 145 150 155 160

Asp Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp
 165 170 175

Ile Asp

<210> 126

<211> 178

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 126

Arg Ala Glu Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala
 1 5 10 15

Lys Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn
 20 25 30

Ser Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp
 35 40 45

Tyr His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn
 50 55 60

Gly Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn
 65 70 75 80

Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr
 85 90 95

Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser
 100 105 110

Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn
 115 120 125

Ser Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu
 130 135 140

Arg Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu
 145 150 155 160

Asp Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp
 165 170 175

Ile Asp

<210> 127

<211> 177

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 127

Arg Ala Glu Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala
 1 5 10 15

Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 128

<211> 177

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 128

Arg Ala Glu Lys Ala Met Val Asp Gly Ala Lys Phe Val Ala Ala Trp
 1 5 10 15

Thr Leu Lys Ala Ala Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 129

<211> 178

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 129

Arg Ala Glu Lys Ala Met Val Asp Gly Ser Ala Lys Phe Val Ala Ala
 1 5 10 15

Trp Thr Leu Lys Ala Ala Ala Gln Pro Phe Ala His Leu Thr Ile Asn
 20 25 30

Ser Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp
 35 40 45

Tyr His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn
 50 55 60

Gly Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn
 65 70 75 80

Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr
 85 90 95

Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser
 100 105 110

Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn
 115 120 125

Ser Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu
 130 135 140

Arg Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu
 145 150 155 160

Asp Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp
 165 170 175

Ile Asp

<210> 130

<211> 176

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 130

Arg Ala Glu Lys Ala Met Val Asp Ala Lys Phe Val Ala Ala Trp Thr
 1 5 10 15

Leu Lys Ala Ala Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr
 20 25 30

Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His
 35 40 45

Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys
 50 55 60

Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys
 65 70 75 80

Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln
 85 90 95

Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His
 100 105 110

Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu
 115 120 125

Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser
 130 135 140

Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro
 145 150 155 160

Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170 175

<210> 131

<211> 177

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variant with PADRE in stalk region

<400> 131

Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Leu Ala Lys
 1 5 10 15

Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 132

<211> 177

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 132

Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Lys
 1 5 10 15

Arg Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser
 20 25 30

Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr
 35 40 45

His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly
 50 55 60

Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val
 65 70 75 80

Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu
 85 90 95

Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser
 100 105 110

His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser
 115 120 125

Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg
 130 135 140

Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp
 145 150 155 160

Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile
 165 170 175

Asp

<210> 133

<211> 174

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 133

Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Lys
 1 5 10 15

Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr Asp Ile
 20 25 30

Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp Arg
 35 40 45

Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys Leu Ile
 50 55 60

Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys Phe Arg
 65 70 75 80

His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu Met
 85 90 95

Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His Thr Leu
 100 105 110

Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu Phe His
 115 120 125

Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser Gly Glu
 130 135 140

Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro Glu Gln
 145 150 155 160

Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170

<210> 134

<211> 175

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 134

Glu Lys Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ser
 1 5 10 15

Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr Asp
 20 25 30

Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp
 35 40 45

Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys Leu
 50 55 60

Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys Phe
 65 70 75 80

Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu
 85 90 95

Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His Thr
 100 105 110

Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu Phe
 115 120 125

His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser Gly
 130 135 140

Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro Glu
 145 150 155 160

Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170 175

<210> 135

<211> 180

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 135

Glu Lys Ala Met Val Asp Gly Ser Trp Leu Asp Leu Ala Lys Phe Val
 1 5 10 15

Ala Ala Trp Thr Leu Lys Ala Ala Ala Gln Pro Phe Ala His Leu Thr
 20 25 30

Ile Asn Ser Thr Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser
 35 40 45

Ser Trp Tyr His Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe
 50 55 60

Ser Asn Gly Lys Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr
 65 70 75 80

Ala Asn Val Cys Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr
 85 90 95

Glu Tyr Leu Gln Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile
 100 105 110

Pro Ser Ser His Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser
 115 120 125

Gly Asn Ser Glu Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe
 130 135 140

Lys Leu Arg Ser Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser
 145 150 155 160

Leu Leu Asp Pro Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val
 165 170 175

Arg Asp Ile Asp
180

<210> 136
<211> 176
<212> PRT
<213> Artificial sequence

<220>
<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 136

Glu Lys Ala Met Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala
1 5 10 15

Ala Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr
20 25 30

Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His
35 40 45

Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys
50 55 60

Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys
65 70 75 80

Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln
85 90 95

Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His
100 105 110

Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu
115 120 125

Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser
130 135 140

Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro
145 150 155 160

Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
165 170 175

<210> 137

<211> 176

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 137

Glu Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Lys Arg
 1 5 10 15

Ser Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr
 20 25 30

Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His
 35 40 45

Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys
 50 55 60

Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys
 65 70 75 80

Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln
 85 90 95

Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His
 100 105 110

Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu
 115 120 125

Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser
 130 135 140

Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro
 145 150 155 160

Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170 175

<210> 138

<211> 175

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 138

Glu Ala Lys Phe Val Ala Ala Trp Thr Leu Lys Ala Ala Ala Arg Ser
1 5 10 15

Lys Leu Glu Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr Asp
20 25 30

Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp
35 40 45

Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys Leu
50 55 60

Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys Phe
65 70 75 80

Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu
85 90 95

Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His Thr
100 105 110

Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu Phe
115 120 125

His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser Gly
130 135 140

Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro Glu
145 150 155 160

Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
165 170 175

<210> 139

<211> 175

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 139

Glu Lys Ala Met Val Asp Gly Ala Lys Phe Val Ala Ala Trp Thr Leu
1 5 10 15

Lys Ala Ala Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr Asp
20 25 30

Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp
35 40 45

Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys Leu
50 55 60

Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys Phe
65 70 75 80

Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu
85 90 95

Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His Thr
100 105 110

Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu Phe
115 120 125

His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser Gly
130 135 140

Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro Glu
145 150 155 160

Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
165 170 175

<210> 140

<211> 176

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 140

Glu Lys Ala Met Val Asp Gly Ser Ala Lys Phe Val Ala Ala Trp Thr
1 5 10 15

Leu Lys Ala Ala Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr
 20 25 30

Asp Ile Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His
 35 40 45

Asp Arg Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys
 50 55 60

Leu Ile Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys
 65 70 75 80

Phe Arg His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln
 85 90 95

Leu Met Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His
 100 105 110

Thr Leu Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu
 115 120 125

Phe His Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser
 130 135 140

Gly Glu Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro
 145 150 155 160

Glu Gln Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170 175

<210> 141

<211> 174

<212> PRT

<213> Artificial sequence

<220>

<223> Immunogenic RANKL variants with PADRE in truncated stalk region

<400> 141

Glu Lys Ala Met Val Asp Ala Lys Phe Val Ala Ala Trp Thr Leu Lys
 1 5 10 15

Ala Ala Ala Gln Pro Phe Ala His Leu Thr Ile Asn Ser Thr Asp Ile
 20 25 30

Pro Ser Gly Ser His Lys Val Ser Leu Ser Ser Trp Tyr His Asp Arg
 35 40 45

Gly Trp Gly Lys Ile Ser Asn Met Thr Phe Ser Asn Gly Lys Leu Ile
 50 55 60

Val Asn Gln Asp Gly Phe Tyr Tyr Ile Tyr Ala Asn Val Cys Phe Arg
 65 70 75 80

His His Glu Thr Ser Gly Asp Leu Ala Thr Glu Tyr Leu Gln Leu Met
 85 90 95

Val Tyr Val Thr Lys Thr Ser Ile Lys Ile Pro Ser Ser His Thr Leu
 100 105 110

Met Lys Gly Gly Ser Thr Lys Tyr Trp Ser Gly Asn Ser Glu Phe His
 115 120 125

Phe Tyr Ser Val Asn Val Gly Gly Phe Phe Lys Leu Arg Ser Gly Glu
 130 135 140

Glu Ile Ser Ile Glu Val Ser Asn Pro Ser Leu Leu Asp Pro Glu Gln
 145 150 155 160

Asp Ala Thr Tyr Phe Gly Ala Phe Lys Val Arg Asp Ile Asp
 165 170

<210> 142

<211> 5785

<212> DNA

<213> Artificial sequence

<220>

<223> pET vector sequence with codon optimised insert encoding RANKL
 sequence

<400> 142

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tcataagggtt tccttgtcaa gctggatatca tgatcgcggc tggggcaaga tttcaaatat	180
gaccttcagc aatggcaagt tgattgtcaa tcaagacggc ttttattatc tgtatgcgga	240
tatctgcttt cgccaccacg agacttccgg tgatcttgca accgagtacc tgcaacttat	300
gggtctacgtg actaagacct ccattaagat cccgtcatcc cataccttga tgaagggtag	360
gtcgactaag tactggagtg gcaattccga gtttcatttc tacagcgtga atgtgggtgg	420

cttttttaag cttcggagcg gcgaggagat ctccatcgag gttagtaatc ccagcctgct	480
ggatccccgag caggatgcc aactacttcgg tgccttcaaa gttcgcgata ttgattaaaa	540
gcttgccggcc gactcgcagc accaccacca ccaccactga gatccggctg ctaacaaagc	600
ccgaaaggaa gctgagttgg ctgctgccac cgctgagcaa taactagcat aacccttgg	660
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gaatgggacg cgccctgtag cggcgcatta agcgcggcgg gtgtggtggt tacgcgcagc	780
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cgatttagtg ctttacggca cctcgacccc aaaaaacttg attagggtga tggttcacgt	960
agtgggcat cgccctgata gacggttttt cgcccttga cgttgagtc cacgttcttt	1020
aatagtggac tcttgttcca aactggaaca acactcaacc ctatctcggc ctattctttt	1080
gatttataag ggattttgcc gatttcggcc tatttggttaa aaaatgagct gatttaacaa	1140
aaatttaacg cgaattttta caaaatatta acgtttacaa tttcaggtgg cacttttcgg	1200
ggaaatgtgc gcggaacccc tatttgttta tttttctaaa tacattcaaa tatgtatccg	1260
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accatgagtg acgactgaat ccggtgagaa tggcaaaagt ttatgcattt ctttcagac	1560
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gagtaaccat gcatcatcag gactacggat aaaatgcttg atggtcggaa gaggcataaa	1860
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acctgattgc ccgacattat cgcgagccca tttataccca tataaatcag catccatgtt	2040
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tgtattactg tttatgtaag cagacagttt tattgttcat gaccaaatac ctttaacgtg	2160

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ctggatcatcc	agcggatagt	taatgatcag	cccactgacg	cggtgcgcga	gaagattgtg	4980
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gcggttggga	atgtaattca	gctccgccat	cgccgcttcc	actttttccc	gcgttttctc	5220
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gacgctctcc	cttatgcgac	tcctgcatta	ggaagcagcc	cagtagtagg	ttgaggccgt	5460
tgagcaccgc	cgccgcaagg	aatggtgcat	gcaaggagat	ggcgcccaac	agtcccccg	5520
ccacggggcc	tgccaccata	cccacgccga	aacaagcgct	catgagccc	aagtggcgag	5580
cccgatcttc	cccatcggtg	atgtcggcga	tataggcgcc	agcaaccgca	cctgtggcgc	5640
cggtgatgcc	ggccacgatg	cgtccggcgt	agaggatcga	gatctcgatc	ccgcgaaatt	5700

aatacgactc actatagggg aattgtgagc ggataacaat tcccctctag aaataatttt 5760
gtttaacttt aagaaggaga tatac 5785

<210> 143
<211> 5785
<212> DNA
<213> Artificial sequence

<220>
<223> pET vector with insert encoding RANKL

<400> 143
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tcataaagtt tcgttgtaa gctggtacca tgatcgtggc tgggcgaaaa tttcaaacat 180
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<213> Artificial sequence

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<220>
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