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Proudite from Tennant Creek, Northern Territory, Australia: its crystal structure and relationship with weibullite and wittite

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Abstract

Proudite, from the Juno Mine at Tennant Creek, Northern Territory, Australia, is monoclinic, space group $C2/m$, with $a = 31.96(1)$, $b = 4.12(1)$, $c = 36.69(3)$ Å, $\beta = 109.52(3)°$ and has a known range of solid solution expressed by the general formula $Cu_xPb_{7.5}Bi_{9.67-0.33x}(S_y, Se_{1-y})_{22}$, where $0.04 < x < 0.98$ and $0.57 < y < 0.82$. Single-crystal X-ray data were collected using the integrating Weissenberg equi-inclination method with multiple film packs; and the structure was solved by the Patterson method and refined by a least-squares procedure to give a final R of 0.17. The asymmetric unit contains 8 Pb, 10 Bi, 1 Cu, and 23 S atom sites. The Cu site, one Bi, and two S sites are partially occupied and the solid solution $Pb_{7.5}Bi_{9.67}(S,Se)_{22} \rightleftharpoons CuPb_{7.5}Bi_{9.33}(S,Se)_{22}$ probably exists. Pb and Bi atoms may be distinguished with only a moderate degree of confidence on the basis of differences in their bonding geometry; the selenium is preferentially ordered into seven of the anion lattice sites. The structure of proudite is closely related to that of junoite, $Cu_2Pb_3Bi_8(S,Se)_{16}$, the other main selenium-rich mineral intergrown with proudite at Juno. This study also incorporates new X-ray and chemical data on the little studied seleniferous sulphosalts wittite and weibullite, and proves that all three are distinct mineral species. Zoning of bismuth-rich sulphosalts in the ore bodies at Juno is discussed.

Introduction

Selenium substitutes for sulphur in many sulphide and sulphosalt minerals, so that distinct Se minerals rarely occur in massive sulphide deposits. Sulphides and selenides are present together because they have formed either at different periods of mineralization or at times when the mineralizing solutions were considerably deficient in S. In contrast to sulphur, which under natural conditions forms compounds of one type or another with at least 40 chemical elements, selenium does so with just a few of higher atomic number. Selenium compounds with light metals do not exist in nature, and there is a predominance of selenides of copper, silver, and bismuth, and notably a lack of compounds with gold which is so specific for its analog tellurium (Sindeeva, 1964).

Although relatively few selenium minerals have been reported as distinct species, there are many descriptions of selenium-bearing minerals in the literature. Sulphur–selenium isomorphism in them is extensive and often unlimited, as is illustrated both in synthetic compounds and in natural specimens, *e.g.* the solid solutions PbS–PbSe and Bi_2S_3–Bi_2Se_3 (Earley, 1950), where 1:1 replacement of S by Se is possible. In particular, the selenide minerals of lead and bismuth included in this type are clausthalite, PbSe, isomorphous with galena; guanajuatite, $Bi_2(S,Se)_3$, isomorphous with bismuthinite; and paraguanajuatite, Bi_2Se_3, which has a structure analogous to tetradymite (Bi_2Te_2S). Other reported occurrences of somewhat more complex lead–bismuth sulphosalts which also fall into this category of sulphur–selenium isomorphism are laitakarite, Bi_4SSe_2, (Vorma, 1960); selenocosalite (Ödman, 1941); selenolillianite, $Pb_3Bi_2(S,Se)_6$, and selenogoongarite, $Pb_4Bi_2(S,Se)_7$ (by Isaksson; see Grip and Wirstam, 1970). These occurrences, at Orijarvi, Finland, and the Boliden Mine, Sweden, must be regarded as somewhat doubtful, particularly selenocosalite which appears to have the wrong composition for it to be a Se-isomorph of cosalite, and selenogoongarite for the reason that goongarite itself is a discredited mineral. Laitakarite and ikunolite, $Bi_4(S,Se)_3$ (Kato, 1959), are reported to be isostructural with joseite-A, $Bi_{4+x}Te_{1-x}S_2$.

TABLE 7 (Structure factor table: approx. 1300 entries)

H	K	L	Y(OBS)	Y(CALC)
36	0	-1	420.23	263,27
36	0	-2	746.53	754,10
36	0	-3	440.60	208,67
36	0	-6	1035.55	1072,88
36	0	-8	820.14	742,23
36	0	-9	537.61	257,29
36	0	-10	339.85	305,95
36	0	-15	840.54	940,69
36	0	-16	484.05	174,61
36	0	-17	681.76	253,59
36	0	-18	587.09	325,04
36	0	-20	471.57	278,81
36	0	-21	1475.03	1363,65
36	0	-22	1660.15	1130,61
36	0	-23	907.03	979,46
34	0	0	967.45	945,76
34	0	-1	1101.56	771,72
34	0	-2	866.97	748,66
34	0	-5	518.95	795,07
34	0	-6	523.49	322,65
34	0	-7	372.88	212,98
34	0	-9	376.92	253,30
34	0	-10	926.62	985,30
34	0	-11	848.06	1082,45
34	0	-12	1201.17	1163,04
34	0	-17	753.96	786,44
34	0	-18	750.40	606,42
34	0	-20	2221.73	2148,28
34	0	-22	2569.40	2565,50
32	0	-23	774.18	426,32
34	0	-24	867.50	842,71
34	0	-26	838.51	344,15
32	0	5	1156.27	1091,45
32	0	3	514.61	209,71
32	0	2	979.63	903,10
32	0	1	2058.89	2165,44
32	0	0	1204.31	1039,58
32	0	-1	1722.35	1952,16
32	0	-2	777.67	814,62
32	0	-3	784.02	770,38
32	0	-4	683.63	114,93
32	0	-5	793.90	908,76
32	0	-9	2204.18	2101,47
32	0	-10	987.33	529,66
32	0	-11	1397.69	1453,31
32	0	-12	1276.45	1201,02
32	0	-13	1141.54	939,95
32	0	-16	984.73	655,10
32	0	-17	283.53	316,85
32	0	-19	397.94	387,36
32	0	-20	395.90	95,04
32	0	-22	552.27	676,74
32	0	-29	1222.30	1287,06

36	0	-18	587.09	325,04
36	0	-20	471.57	278,81
36	0	-21	1475.03	1363,65
36	0	-22	1660.15	1130,61
36	0	-23	907.03	979,46
34	0	0	967.45	945,76
34	0	-1	1101.56	771,72
34	0	-2	866.97	748,66
34	0	-5	518.95	795,07
34	0	-6	523.49	322,65
34	0	-7	372,88	212,98
34	0	-9	376.92	253,30
34	0	-10	926.62	985,30
34	0	-11	848.06	1082,45
34	0	-12	1201.17	1163,04
34	0	-17	753.96	786,44
34	0	-18	750.40	606,42
34	0	-20	2221.73	2148,28
34	0	-22	2569.40	2565,50
32	0	-23	774,18	426,32
34	0	-24	867.50	842,71
34	0	-26	838.51	344,15
32	0	5	1156,27	1091,45
32	0	3	514.61	209,71
32	0	2	979.63	903,10
32	0	1	2058.89	2165,44
32	0	0	1204.31	1039,58
32	0	-1	1722.35	1952,16
32	0	-2	777.67	814,62
32	0	-3	784.02	770,38
32	0	-4	683.63	114,93
32	0	-5	793,90	908,76
32	0	-9	2204.18	2101,47
32	0	-10	987.33	529,66
32	0	-11	1397,69	1453,31
32	0	-12	1276.45	1201,02
32	0	-13	1141.54	939,95
32	0	-16	984.73	655,10
32	0	-17	283,53	316,85
32	0	-19	397.94	387,36
32	0	-20	395.90	95,04
32	0	-22	552.27	676,74
32	0	-29	1222.30	1287,06
30	0	10	1191.22	1281,12
30	0	9	708.39	801,67
30	0	8	1027.90	789,36
30	0	3	770,19	556,27

②

H	K	L	Y(OBS)	Y(CALC)
36	0	-1	420.23	263,27
36	0	-2	746.53	754,10
36	0	-3	440.60	208,67
36	0	-6	1035.55	1072,88
36	0	-8	820.14	742,23
36	0	-9	337.61	257,29
36	0	-10	339.85	305,95
36	0	-15	840.54	940,69
36	0	-16	484.05	174,61
36	0	-17	681,76	253,59
36	0	-18	587.09	325,04
36	0	-20	471.57	278.81

(3)

MUMME – TABLE 7 ('Stanstine factor table')

36	0	-21	1475.03	1363,65
36	0	-22	1668.15	1130,61
36	0	-23	987.03	979,45
34	0	0	967,45	985,76
34	0	-1	1101.56	771,72
34	0	-2	806,97	748,66
34	0	-5	518,95	799,07
34	0	-6	525,49	322,65
34	0	-7	372,88	212,98
34	0	-9	376,92	253,30
34	0	-10	926,62	988,30
34	0	-11	848,06	1082,45
34	0	-12	1201,17	1163,04
34	0	-17	753,96	706,44
34	0	-18	750.40	606,42
34	0	-20	2221.73	2140,28
34	0	-22	2569,40	2565,50
32	0	-23	774,18	426,32
34	0	-24	867,50	842,71
34	0	-26	838,31	344,13
32	0	5	1156,27	1091,45
32	0	3	[illegible]	209,71
32	0	2	979,63	903,10
32	0	1	2058.89	2165,44
32	0	0	1209.31	1039,38
32	0	-1	1722,35	1952,16
32	0	-2	777,67	814,62
32	0	-3	784,02	770,38
32	0	-4	683,63	114,93
32	0	-5	793,20	908,76
32	0	-9	2204,18	2101,47
32	0	-10	987,33	329,66
32	0	-11	1397,69	1453,31
32	0	-12	1276.45	1201,02
32	0	-13	1141,54	939,95
32	0	-16	984,73	655,10
32	0	-17	285,53	316,85
32	0	-19	387,94	387,36
32	0	-20	395,90	95,04
32	0	-22	552,27	676,74
32	0	-29	1222,30	1287,06
30	0	10	1191,22	1281,12
30	0	9	708,39	801,67
30	0	8	1027,20	789,36
30	0	5	770,19	556,27
30	0	2	1396,42	1604,89
30	0	0	1145,76	965,60
30	0	-1	705,44	622,12
30	0	-2	818,09	480,35
30	0	-6	825,83	748,84
30	0	-7	1012,51	1206,26
30	0	-8	1013,26	1094,58
30	0	-10	827,97	899,40
30	0	-11	814,05	194,38
30	0	-12	414,04	219,86
30	0	-14	716,83	408,50
30	0	-19	503,96	642,73
30	0	-20	820,80	1003,64
30	0	-28	942,97	812,41
30	0	-31	513,68	283,84
30	0	-32	1091,20	1055,22
28	0	13	1030,42	1007,25

28	0	10	269,48	130,62
28	0	9	549,15	90,58
28	0	7	692,08	551,69
28	0	6	699,36	476,44
28	0	3	713,10	719,29
28	0	0	829,02	365,86
28	0	-1	586,48	308,75
28	0	-4	414,12	173,52
28	0	-5	585,12	610,30
28	0	-6	826,69	696,59
28	0	-7	825,96	130,69
28	0	-8	583,60	733,60
28	0	-9	824,88	832,28
28	0	-10	824,62	768,50
28	0	-11	824,57	854,91
28	0	-13	412,56	24,40
28	0	-14	412,83	395,59
28	0	-15	715,64	631,18
28	0	-16	413,56	318,20
28	0	-17	1433,99	1495,32
28	0	-18	414,31	688,36
28	0	-19	293,16	227,93
28	0	-20	293,25	356,51
28	0	-22	585,87	890,16
28	0	-24	291,61	285,39
28	0	-26	1732,67	1728,57
28	0	-27	2293,14	2428,80
28	0	-28	1502,48	1615,98
28	0	-30	533,20	89,31
28	0	-31	543,70	266,84
28	0	-32	266,32	312,22
26	0	14	1068,09	942,17
26	0	11	309,63	334,82
26	0	9	408,42	333,88
26	0	5	414,70	759,03
26	0	2	826,21	735,62
26	0	0	821,17	670,55
26	0	-3	497,57	209,99
26	0	-5	1510,61	1537,60
26	0	-6	2847,51	2876,46
26	0	-7	2273,33	2354,60
26	0	-9	400,90	843,92
26	0	-13	696,17	548,73
26	0	-15	1277,01	1362,57
26	0	-16	1280,84	1428,85
26	0	-17	1817,40	1797,72
26	0	-18	1153,47	1276,28
26	0	-20	410,71	604,20
26	0	-21	1009,29	884,75
26	0	-24	1015,59	1056,19
26	0	-25	1658,72	1741,51
26	0	-26	1434,75	1184,04
26	0	-27	1752,18	1869,40
26	0	-28	411,02	530,16
26	0	-29	1154,39	1163,79
24	0	16	1551,67	1158,29
24	0	15	1502,86	1506,32
24	0	14	696,35	589,01
24	0	6	1746,09	1522,04
24	0	5	2166,80	2163,40
24	0	4	1628,42	1676,92

24	0	1	1128,79	1049,40
24	0	0	792,02	813,01
24	0	-2	782,89	463,21
24	0	-4	2738,95	2634,39
24	0	-5	2358,56	2381,77
22	0	-7	883,74	471,59
24	0	-8	1210,58	1031,64
24	0	-10	382,68	172,62
24	0	-11	1211,65	1203,16
24	0	-13	861,28	912,46
24	0	-14	1640,58	1502,84
24	0	-15	1737,43	1667,87
24	0	-16	1100,74	979,84
24	0	-17	960,41	930,20
24	0	-19	979,03	628,17
20	0	-23	1155,71	977,34
24	0	-24	1161,94	919,38
22	0	17	1607,65	1815,88
22	0	16	1523,91	1437,33
22	0	15	2016,01	2040,69
22	0	14	827,01	563,02
22	0	13	586,34	849,72
22	0	10	582,13	173,11
22	0	8	574,09	325,38
22	0	7	1505,75	1529,13
22	0	6	1491,56	1570,52
22	0	5	1670,47	1348,87
22	0	3	773,31	783,73
22	0	2	1210,39	1304,55
22	0	0	671,44	607,03
22	0	-2	1108,25	839,14
22	0	-5	1702,50	1543,15
22	0	-9	624,23	688,88
22	0	-10	721,77	399,83
22	0	-13	2920,13	2974,53
22	0	-15	1479,31	1512,28
22	0	-17	651,32	469,07
22	0	-18	699,90	608,30
22	0	-22	1118,01	1302,62
22	0	-23	399,22	128,00
22	0	-25	406,44	71[illegible],00
22	0	-27	921,16	1107,52
22	0	-32	502,92	464,76
22	0	-33	1521,28	1637,12
22	0	-35	787,43	705,80
20	0	20	399,33	544,17
20	0	19	286,89	80,29
20	0	18	1535,27	1675,61
20	0	15	717,98	494,81
20	0	15	414,53	494,81
20	0	12	998,71	1123,17
20	0	12	998,71	1123,17
20	0	9	1113,91	1249,53
20	0	8	1101,50	1204,02
20	0	5	630,10	846,88
20	0	0	992,75	842,06
20	0	-1	581,43	872,33
20	0	-3	837,13	964,46
20	0	-6	336,83	353,79
20	0	-8	1257,71	1360,28
20	0	-9	824,4[illegible]	672,38
20	0	-11	838,46	371,77

20	0	-12	3880,25	3837,31
20	0	-14	1549,55	1476,13
20	0	-16	1118,24	1029,20
20	0	-20	1176,65	1013,95
20	0	-21	1769,53	1730,71
20	0	-22	1622,91	1781,10
20	0	-23	775,56	829,35
20	0	-24	392,93	174,53
20	0	-25	562,67	257,26
20	0	-26	985,80	838,02
20	0	-30	828,49	772,26
20	0	-31	1172,96	1356,44
20	0	-32	2617,20	2631,14
20	0	-34	[illegible],87	664,84
18	0	23	964,31	1350,47
18	0	2[illegible]	407,81	345,66
18	0	20	411,89	248,02
18	0	19	1014,43	1011,36
18	0	16	260,24	191,93
18	0	15	408,08	70,48
18	0	14	807,52	1144,84
18	0	13	1260,82	1249,61
18	0	12	786,19	714,02
18	0	9	648,52	610,93
18	0	7	511,46	833,06
18	0	2	447,44	538,72
18	0	1	569,78	417,89
18	0	-1	2271,79	2412,22
18	0	-2	2110,78	2281,99
18	0	-3	705,84	959,17
18	0	-4	1330,82	1234,78
18	0	-7	381,15	788,15
18	0	-10	1831,22	1854,50
18	0	-11	2827,78	2792,12
18	0	-12	1275,25	1637,19
18	0	-13	1115,45	892,27
18	0	-16	1057,87	919,57
18	0	-21	2295,84	2369,66
18	0	-22	1567,11	1398,74
18	0	-23	751,59	838,65
18	0	-24	1080,95	702,45
18	0	-25	475,68	436,66
18	0	-27	692,54	687,20
18	0	-28	809,49	939,08
18	0	-29	1156,50	1090,19
18	0	-30	1165,47	1228,08
18	0	-31	2028,50	2110,31
18	0	-32	1759,48	1766,09
16	0	16	490,61	345,61
16	0	15	394,60	381,77
16	0	11	1268,82	1107,67
16	0	10	4245,53	4318,74
16	0	9	1791,87	2005,27
16	0	8	973,45	1187,64
16	0	7	1581,31	1400,50
16	0	5	1122,27	392,33
16	0	5	647,94	392,33
16	0	3	1081,93	607,18
16	0	1	1131,95	929,89
16	0	0	2984,06	3171,17
16	0	-1	509,70	299,60
16	0	-2	714,9[illegible]	[illegible]

16	0	-3	1976,30	1400,14
16	0	-5	1282,30	1076,17
16	0	-6	1071,30	1125,98
16	0	-8	406,54	302,86
16	0	-9	2238,79	2533,62
16	0	-10	4811,57	4497,37
16	0	-11	2120,32	2046,26
16	0	-12	420,65	154,27
14	0	-13	1129,43	997,76
16	0	-14	865,34	1239,78
16	0	-15	761,71	426,46
16	0	-18	1138,72	1006,59
16	0	-19	1837.00	1806,14
16	0	-20	2054.11	2077,60
16	0	-21	1712,45	1559,20
16	0	-26	772,52	718,26
16	0	-28	798,25	693,72
16	0	-29	1144.22	1821,89
20	0	-30	828,49	772,26
14	0	21	2609,89	2881,79
14	0	20	1531,37	1348,26
14	0	19	809,12	981,01
14	0	12	1927,97	2080,39
14	0	11	3223,67	3291,15
14	0	10	2012,48	1709,95
14	0	9	1308,95	1352,61
14	0	8	1750,51	1579,69
14	0	7	2961,08	2998,08
14	0	5	843,70	468,87
14	0	4	357,65	119,36
14	0	2	1863,62	1777,70
14	0	1	1913,85	1827,66
14	0	0	3173,53	3193,20
14	0	-5	1227,53	1042,11
14	0	-8	1868,53	1955,02
14	0	-9	461,68	373,65
14	0	-10	1143,60	1232,49
14	0	-13	847,87	997,76
14	0	-14	761,39	326,15
14	0	-16	1200,44	1234,38
14	0	-17	1789.77	1743,36
14	0	-19	454,99	735,22
14	0	-20	329,58	304,40
14	0	-22	489.25	97,59
14	0	-25	371.00	243,06
14	0	-28	682.41	765,77
14	0	-29	800.91	868,81
14	0	-30	574,15	498,43
12	0	23	923.36	983,32
12	0	22	1532,36	1836,10
12	0	21	700,88	592,76
12	0	18	767,05	1091,59
12	0	16	517,24	80,90
12	0	14	778,10	516,13
12	0	13	1267,60	1292,81
12	0	12	807,51	712,55
12	0	10	1708,62	1634,90
12	0	9	1662,13	1718,90
12	0	8	835.18	864,84
12	0	6	485,01	760,37
12	0	3	2017,72	2230,29
12	0	1	612.98	821.48

12	0	-4	822.18	284,35
12	0	-7	3555.14	3535,70
12	0	-8	838.85	647,86
12	0	-9	1344,17	1398,54
12	0	-11	1244,76	1269,69
12	0	-13	375,19	276,64
12	0	-15	965,26	128,35
12	0	-16	3132,99	3308,44
12	0	-17	3217,96	3398,32
12	0	-19	1316,52	1358,08
12	0	-21	568,01	85,13
12	0	-27	2415,66	2127,13
12	0	-29	973,02	659,19
10	0	21	680,21	751,82
10	0	20	666,10	653,65
10	0	19	1680,41	1570,91
10	0	18	1269,37	1338,20
10	0	15	825,67	552,38
10	0	14	925,47	1088,98
10	0	13	1099,59	724,22
10	0	11	1399.52	1204,14
10	0	10	1001,84	980,24
10	0	9	560,63	263,85
10	0	7	372,68	705,35
10	0	4	3580,79	3720,57
10	0	2	973,07	578,26
10	0	1	951,79	916,58
10	0	-3	521,60	336,78
10	0	-5	522,48	520,71
10	0	-6	1360.11	990,21
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10	0	-8	1715,40	1837,03
10	0	-10	924,92	1064,00
10	0	-11	749.99	541,49
10	0	-14	730,63	510,93
10	0	-16	6016,75	6139,71
10	0	-17	1133,24	955,62
10	0	-18	826,75	711,31
10	0	-19	852,95	658,17
10	0	-20	1077.54	1086,25
10	0	-22	739,15	190,59
10	0	-23	1275,85	1180,71
10	0	-26	3048,24	3201,33
10	0	-27	847,07	1272,15
10	0	-31	1155.43	1172,15
8	0	25	816,88	1098,87
8	0	21	757,68	708,56
8	0	20	1279.27	1572,22
8	0	19	622,34	146,71
8	0	15	3392,09	3264,26
8	0	12	806,00	462,92
8	0	6	1137,17	1051,11
8	0	5	6573,17	6590,00
8	0	4	866,56	1364,44
8	0	3	985.60	528,25
8	0	2	1819,70	1744,07
8	0	-4	1188,07	1131,69
8	0	-5	7592.24	7348,58
8	0	-6	1704.75	1751,08
8	0	-10	431,45	255,47
8	0	-14	1921,26	1577,55
8	0	-18	3563.18	[illegible]

8	0	-16	1305.34	1816,38
8	0	-18	404,22	191,79
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8	0	-21	1613,19	1571,93
8	0	-22	1729,32	1862,49
8	0	-24	1630,95	1548,61
8	0	-25	1753,90	1684,89
8	0	-20	809,69	330,92
6	0	26	4600,61	4261,11
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6	0	14	817,54	902,99
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6	0	10	700,52	687,03
6	0	9	237,77	137,23
6	0	7	2374,31	2643,22
6	0	6	4186,84	4128,93
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6	0	-4	1421,68	1416,07
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4	0	18	839,83	779,72
4	0	17	2371,58	2214,79
4	0	16	589,93	232,73
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4	0	14	2282,61	2061,31
4	0	13	1228,44	1423,99
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4	0	-19	1101,01	1046,85
4	0	-20	1366,03	1693,58
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2	0	28	1073,02	822,42
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27	1	-12	601,65	383,63
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27	1	-18	604.97	518,32
27	1	-21	1914,55	2134,45
25	1	-8	1012.84	633,56
25	1	-11	1432,16	1219,98
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25	1	-14	587.98	152,50
25	1	-15	833,82	555,74
25	1	-17	593,64	301,05
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25	1	-22	853,89	415,64
25	1	-24	856,38	593,64
23	1	-9	1673.16	1326,39
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23	1	-16	807.73	748,37
23	1	-17	812.84	768.57

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23	1	-20	1552,31	1353,90
23	1	-21	417,72	190,67
23	1	-22	840,87	597,78
23	1	-27	605,59	615,16
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21	1	-10	832,80	651,71
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21	1	-17	2134,80	2265,75
21	1	-18	2361.69	1897,82
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21	1	-28	1352,96	1095,26
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19	1	-19	1080.06	981,16
19	1	-20	1095,28	120,75
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17	1	-18	881,24	1034,81
17	1	-19	1035,28	489,73
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15	1	-14	1103,22	1214,53
15	1	-15	458,46	461,71
15	1	-18	486,42	226,71
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13	1	-13	3947,01	3566,78
13	1	-14	1471.83	1872,85
13	1	-16	314,41	138,43
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13	1	-22	1262,06	869,29
13	1	-23	2475,02	2590,01
13	1	-24	1527,26	2119,16
13	1	-25	955,98	109,00
13	1	-26	563,37	160,05
13	1	-32	1353,72	1356,60
11	1	-10	895,69	1218,64
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11	1	-13	1519,23	1313,17
11	1	-15	1308,79	877,99
11	1	-17	619,20	1186,49
11	1	-20	504,14	711,60

11	1	-23	1035,63	855,54
11	1	-24	920,23	874,33
11	1	-25	666,79	313,96
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9	1	-11	782,87	402,11
9	1	-13	1054,08	1672,40
9	1	-14	1490,65	454,67
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9	1	-16	918,82	1614,37
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9	1	-22	1490,33	1555,86
9	1	-23	626,36	481,02
9	1	-26	553,35	730,29
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9	1	-30	2663,41	2629,05
7	1	-9	2915,65	2737,42
7	1	-10	1353,90	1184,36
7	1	-11	877,39	1229,30
7	1	-12	2068,31	2020,05
7	1	-13	1387,69	997,52
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7	1	-16	802,60	866,23
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7	1	-18	964,65	899,24
7	1	-19	3373,06	3589,56
7	1	-20	924,56	1380,00
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7	1	-29	4553,09	4405,07
7	1	-30	1332,84	840,75
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5	1	-11	1238,82	1444,69
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3	1	-10	847,41	450,94
3	1	-13	494,32	581,89
3	1	-14	517,73	974,15
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3	1	-27	1516,39	897,41
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1	1	-10	860,06	884,74

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1	1	-16	910,05	1002,67
1	1	-17	1642,09	1771,05
1	1	-18	1328,97	1197,24
1	1	-25	2074,54	1635,83
1	1	25	978,45	454,15
1	1	24	2466,62	2899,18
1	1	21	504,36	199,21
1	1	17	535,23	429,01
1	1	16	1626,67	2058,55
1	1	15	987,17	1259,14
1	1	14	4727,85	4586,02
1	1	13	1380,80	1328,27
1	1	12	556,55	1058,76
1	1	8	2354,88	1854,84
1	1	7	2356,08	2126,85
1	1	6	945,54	327,52
1	1	5	1501,80	1460,96
1	1	4	1763,44	2097,17
3	1	24	2185,40	2036,60
3	1	23	2061,97	2427,96
3	1	15	210,45	160,61
3	1	14	495,08	846,06
3	1	13	5342,74	5311,80
3	1	11	613,96	1011,71
3	1	10	977,87	313,07
3	1	9	454,39	403,45
3	1	8	963,23	1801,49
3	1	7	1576,17	1221,67
3	1	6	2966,08	3134,33
3	1	5	1388,95	1383,04
3	1	4	528,36	660,72
3	1	3	4381,50	4562,11
3	1	2	2024,39	2381,45
3	1	1	725,99	1163,69
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5	1	21	1076,63	115,80
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5	1	14	1652,39	1874,50
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5	1	8	332,41	159,59
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5	1	5	1774,71	1923,19
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7	1	19	748,63	1077,07
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7	1	13	1692,27	1685,32
7	1	12	1333,51	918,61

7	1	11	1575,01	1253,72
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9	1	17	524,33	297,73
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9	1	12	1427,24	658,12
9	1	11	1692,73	1504,71
9	1	10	1036,35	1140,85
9	1	9	3145,24	3849,72
9	1	8	1188,83	1212,89
9	1	4	780,37	502,78
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13	1	14	539,45	488,59
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13	1	4	735,23	417,26
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15	1	-5	1382.86	1180,23
15	1	-7	417,48	723,51
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17	1	15	1787,03	723,42
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17	1	13	1301,06	177,87
17	1	11	1129,38	773,30
17	1	7	1025.67	1569,71
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19	1	11	1019.98	1087,41
19	1	8	802,56	662,52
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19	1	4	2683.55	2393,04
19	1	3	2368,09	2122,13
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19	1	1	1154,02	458,64
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19	1	-3	1406.82	1148,65
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21	1	-3	755,22	487,77
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21	1	-6	1053,65	146,31
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21	1	-8	2101,51	2486,43
23	1	10	2707,04	493,79
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23	1	2	827,53	237,27
23	1	1	1299,34	371,58
23	1	-2	1274,22	287,45
23	1	-3	972,85	265,48
23	1	-7	1477.96	407,97
23	1	-8	557,69	134,40
25	1	6	1048.39	817,33
25	1	2	1593,86	1331,70
25	1	1	600,51	431,85
25	1	0	1338.05	1278,80
25	1	-3	836,98	411,86
25	1	-4	509.87	89,73
25	1	-5	831,75	528,38
25	1	-6	829.69	58,47
27	1	2	604,10	274,80
27	1	-1	1816.68	1758.87

27	1	-2	1914,07	359,73
27	1	-3	1710,63	1785,85
36	2	-1	331,12	236,43
36	2	-2	601,60	693,97
36	2	-3	396,30	176,21
36	2	-6	1137,03	981,59
36	2	-8	348,19	718,58
36	2	-9	197,26	250,40
36	2	-10	399,97	244,95
36	2	-15	376,08	885,89
36	2	-16	405,82	138,99
36	2	-17	492,93	238,72
36	2	-18	562,59	283,58
36	2	-20	543,37	262,07
36	2	-21	1325,07	1230,33
36	2	-22	1206,97	1023,85
36	2	-15	865,32	885,89
34	2	0	992,71	935,57
34	2	-1	1150,84	726,41
34	2	-2	968,89	765,68
34	2	-5	463,41	719,20
34	2	-6	332,96	340,23
34	2	-7	337,44	184,58
34	2	-9	486,73	215,57
34	2	-10	979,99	979,25
34	2	-11	550,43	1052,47
34	2	-12	1047,31	1125,24
34	2	-17	807,40	767,45
34	2	-18	241,34	598,40
34	2	-20	1971,01	2155,04
34	2	-22	1903,90	2497,82
34	2	-23	629,59	799,18
34	2	-24	867,61	833,20
34	2	-26	453,85	321,28
32	2	5	1152,68	1051,43
32	2	3	603,64	187,38
32	2	2	999,38	828,12
32	2	1	2165,94	2120,78
32	2	0	1109,30	1021,26
32	2	-1	1601,09	1901,52
32	2	-2	729,50	744,35
32	2	-3	741,03	715,36
32	2	-4	796,66	95,12
32	2	-5	930,56	818,31
32	2	-9	2142,41	1930,98
32	2	-10	877,80	422,57
32	2	-11	1523,86	1404,93
32	2	-12	880,66	1075,62
32	2	-13	1181,15	800,88
32	2	-16	872,65	605,80
32	2	-17	194,02	246,51
32	2	-19	467,68	375,43
32	2	-13	393,72	800,88
32	2	-22	367,78	672,60
32	2	-29	1055,14	1275,29
30	2	10	1156,67	1306,27
30	2	9	433,90	770,85
30	2	8	719,79	736,91
30	2	5	800,02	506,34
30	2	2	1385,83	1315,98
30	2	0	972,75	879,19
30	2	-1	697,06	615,16

15

30	2	-2	814,18	412,26
30	2	-6	785,42	656,44
30	2	-7	1033,11	1025,53
30	2	-8	846,55	977,91
30	2	-10	601,20	813,78
30	2	-11	425,47	139,26
30	2	-12	363,47	170,59
30	2	-14	600.14	365,16
30	2	-18	590,25	830,23
30	2	-19	358,93	581,16
30	2	-20	381.27	888,89
30	2	-28	946.94	810,51
30	2	-31	454,79	310,93
30	2	-32	969,09	1019,32
28	2	13	1290.08	1732,81
28	2	10	175,63	108,19
28	2	9	315,07	49,26
28	2	7	770,28	464,58
28	2	6	482,70	436,69
28	2	3	656.57	642,72
28	2	0	745,28	305,35
28	2	-1	432,47	281,83
28	2	-4	439,47	143,37
28	2	-5	623.66	441,08
28	2	-6	765.92	589,69
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28	2	-8	443,79	612,53
28	2	-9	628,25	694,21
28	2	-10	769.86	662,72
28	2	-11	769.94	730,13
28	2	-13	243,20	39,97
28	2	-14	313.57	311,25
28	2	-15	313.00	536,35
28	2	-16	312,24	295,59
28	2	-17	1164,84	1273,05
28	2	-18	759,45	642,60
28	2	-19	218,17	143,32
28	2	-20	216,89	279,13
28	2	-22	427,03	785,98
28	2	-24	208.87	285,76
28	2	-26	1621,32	1516,02
28	2	-27	2178,81	2140,13
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28	2	-30	260.91	98,25
28	2	-31	564.50	236,64
28	2	-32	486.04	276,28
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26	2	11	272,57	360,43
26	2	9	641.01	273,96
26	2	5	305.48	720,32
26	2	2	626,25	649,22
26	2	0	446.92	560,10
26	2	-3	389,71	204,35
26	2	-5	1425.56	1321,87
26	2	-6	2470.21	2514,37
26	2	-7	2255.53	2025,74
26	2	-9	390,74	643,40
26	2	-13	731,33	454,48
26	2	-15	1184,18	1223,56
26	2	-16	1191,78	1296,61
26	2	-17	1782,63	1510,86
26	2	-18	635,28	1066.68

26	2	-20	446,78	530,37
26	2	-21	1089,90	787,70
26	2	-24	1068,00	894,60
26	2	-25	1495,12	1580,31
26	2	-26	1205,08	1066,00
26	2	-27	1627,25	1681,67
26	2	-28	292,00	480,21
26	2	-29	1144,52	994,83
24	2	16	1148,24	1091,91
24	2	15	1462,05	1397,37
24	2	14	617,13	553,73
24	2	6	1337,08	1307,18
24	2	5	1735,09	1928,06
24	2	4	1271.67	1481,04
24	2	3	1624,68	1496,27
24	2	1	1008,96	873,92
24	2	0	1008.51	672,00
24	2	-2	779,48	388,06
24	2	-4	2243,71	2347,21
24	2	-5	2004,10	2004,23
22	2	-7	867,68	356,21
24	2	-8	1182,43	794,71
24	2	-10	706,54	180,70
24	2	-11	1264,50	1032,28
24	2	-13	708,22	774,88
24	2	-14	1553,65	1279,30
24	2	-15	1489.64	1356,55
24	2	-16	1005,77	933,56
24	2	-17	551.62	812,71
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22	2	16	1609.77	1301,19
22	2	15	1431,50	1883,71
22	2	14	597,49	458,90
22	2	13	608,50	735,41
22	2	10	630.17	179,57
22	2	8	450,13	285,08
22	2	7	1495,92	1351,11
22	2	6	1496,48	1307,21
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22	2	3	896,98	652,25
22	2	2	999,28	987,81
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22	2	-15	1319.73	1318,65
22	2	-17	701.31	384,32
22	2	-18	545,49	547,00
22	2	-22	780.91	1070,56
22	2	-23	451,22	29,82
22	2	-25	636,28	608,24
22	2	-27	832,69	972,82
22	2	-32	504,25	448,37
22	2	-33	1267,10	1472,71
22	2	-35	915,37	609,66
20	2	20	471,11	580,46
20	2	19	488.20	110,29

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20	2	15	535.13	419,48
20	2	13	893.06	702,28
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20	2	9	901.46	1033,96
20	2	8	1100.92	1024,31
20	2	3	924.78	660,77
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20	2	-6	358.88	301,96
20	2	-8	1308.46	1201,91
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20	2	-20	882.58	845,53
20	2	-21	1473.27	1398,00
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18	2	-4	1037.70	950,12
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18	2	-15	2580.68	112,33
18	2	-12	1317.90	1371,27
18	2	-13	981.92	622,18
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18	2	-21	1947.19	2079,60
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18	2	-23	627.08	732,64
18	2	-24	998.69	555,62
18	2	-25	388.94	443,33
18	2	-27	552.64	616,07
18	2	-28	450.54	814,52
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18	2	-31	1458.43	1886,78

16	2	32	1220,17	1574,04
16	2	16	390,75	322,37
16	2	15	637,45	270,43
16	2	11	1312,88	876,67
16	2	10	3867,58	3710,70
16	2	9	1530,66	1729,27
16	2	8	841,58	967,07
16	2	7	1375,29	1168,09
14	2	6	930,80	188,08
16	2	5	402,41	327,24
14	2	3	628,57	108,28
16	2	1	1007,09	873,86
16	2	0	2660,46	2659,23
16	2	-1	322,51	92,39
16	2	-2	904,26	90,21
16	2	-3	1159,19	1031,81
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16	2	-6	889,19	908,14
16	2	-8	446,16	297,39
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16	2	-11	1894,37	1026,72
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16	2	-14	543,40	917,07
16	2	-15	778,90	412,97
16	2	-18	1076,66	882,98
16	2	-19	1431,00	1549,35
16	2	-20	1874,89	1726,49
16	2	-21	1473,12	1450,42
16	2	-26	776,55	564,02
16	2	-28	638,12	518,93
16	2	-29	842,99	808,18
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14	2	19	712,45	815,37
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14	2	11	2700,25	2762,59
14	2	10	1632,47	1495,27
14	2	9	1147,92	1118,15
14	2	8	1379,19	1280,24
14	2	7	2103,62	2332,71
14	2	5	651,47	407,71
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12	2	16	437,60	60,19
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12	2	10	1352,57	1280,30
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10	2	15	829,22	458,25
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8	2	-5	5770,37	3632,46
8	2	-6	1225,44	1407,36
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8	2	-14	1024,73	1316,12
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4	2	16	745,06	51,56
4	2	15	1973,16	2034,95
4	2	14	1738,57	1590,55
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4	2	12	322.14	201,83
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2	2	20	128,32	211,05
2	2	19	882,32	319,93
2	2	17	928.51	493,00
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0	2	20	2440.64	2121,72
0	2	21	1287,37	986,49
0	2	22	1022.63	1196,62
0	2	25	1711,48	1662,13
0	2	26	893,98	925,64
0	2	29	1086.03	670.87