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Neutron Activation Analysis of Clay and Late Third Millennium Pottery from Iktanu, Jericho and Jerusalem: First Results

History

The project was initiated in discussions between Newton and Prag in 1985, and a pilot project with 32 samples was undertaken as part of a third-year student project in 1987/88 by Gavin Elley in the Chemistry Department, University of Manchester. The first samples (Nos. 1-32, TABLE 1) included material excavated by Prag in 1966 from Tall Iktanu (Jordan), including two lots of cooking pot ware and a more heterogeneous set. These three sample sets were compared with two sets of approximately the same late third millennium date from the Kenyon excavations at Jericho (1952-58) and at Jerusalem (1965), which were available in Manchester. The questions addressed in particular were:

- 1) intra-site: whether the clay used for the cooking pots in Phases 1 and 2 on the site could be differentiated;
- 2) inter-site: did similarities exist between clays used at different sites, in particular in the clays containing a large amount of fine calcite grains to which attention has been drawn by Dr. H. J. Franken (Leiden University).

It was evident that much of the Iktanu pottery contains grog temper. To avoid problems in analysis, and to follow up the preliminary results, a second student project analysing a further 34 samples of cooking pot ware which does not contain grog (18 fragments from Phase 1 and 16 fragments from Phase 2 contexts) was undertaken by Stephen Booker in 1988/9 (Nos. 50-67, TABLE 1).

Table 1. Sample list.

Number	Provenance	Description
<i>Iktanu: Intermediate Early Bronze-Middle Bronze Age: tall</i>		
1	IK.140.10.11	Phase 1 (1A) cooking pot
2	IK.170.7.2	Phase 1 (1A) cooking pot
3	IK.170.7.3	Phase 1 (1A) cooking pot
4	IK.170.5.64	Phase 1 (1A) cooking pot
5	IK.170.5.69	Phase 1 (2A) cooking pot
6	IK.170.5.72	Phase 1 (1C) cooking pot
7	IK.100.7.1	Phase 2 (1D) cooking pot
8	IK.110.6a.1	Phase 2 (1D) cooking pot

9	IK.130.2.5	Phase 2 (1D) cooking pot
10	IK.180.1	Phase 2 (1D) cooking pot
11	IK.190.2.8	Phase 2 (?1A) cooking pot
12	IK.502.2.9	Phase 2 (2D) cooking pot
13	IK.190.2.11	Phase 2 Jug
14	IK.190.2.9	Phase 2 cup/small bowl
15	IK.190.2	Phase 2 Jar
16	IK.+.12	Phase 2 Jar
17	IK.+.15	Phase 2 Jar
18	IK.190.8.9	Phase 1 holemouth jar

19	JpT3.4	?Phase 1 holemouth jar
20	JpT3.4	Holemouth jar/'teapot'
21	JpN2.11	Cooking pot (1D)
22	JpJ3.14b	Jar
23	JpJ2.40	Band-combed cup
24	JpJ3.127	Holemouth jar
25	JpJ2.36/4	Small bowl
26	SNJ.2	Jar
27	JpJ2.35	Jar

28	Jm Tomb C1.5	Jar
29	Jm Tomb C1.6	Jar
30	Jm Tomb C2.9	Jar
31	Jm Tomb C2.10	Jar
32	Jm Tomb B2.3	Jar

50	IK.160.6	Phase 1 cooking pot
51	IK.160.6.2	Phase 1 cooking pot
52	IK.160.6.3	Phase 1 cooking pot
53	IK.160.6.4	Phase 1 cooking pot
54	IK.170.4	Phase 1 (1A) cooking pot
55	IK.170.5.61	Phase 1 cooking pot
56	IK.170.5.66	Phase 1 cooking pot
57	IK.170.5.65	Phase 1 cooking pot
58	IK.170.5.70	Phase 1 cooking pot

59	IK.170.7.5	Phase 1 cooking pot
60	IK.170.7.6	Phase 1 cooking pot
61	IK.180.4	Phase 1 (2A) cooking pot
62	IK.140.9.9	Phase 1 cooking pot
63	IK.160.6.1	Phase 1 cooking pot
64	IK.170.5.A	Phase 1 cooking pot
65	IK.170.5.62	Phase 1 cooking pot
66	IK.190.9.A	Phase 1 cooking pot
67	IK.190.9.B	Phase 1 cooking pot
68	IK.160.1.1	Phase 2 cooking pot
69	IK.180.1.C	Phase 2 (1D) cooking pot
70	IK.190.3.1	Phase 2 (1D) cooking pot
71	IK.190.3.2	Phase 2 (1D) cooking pot
72	IK.190.3.3	Phase 2 (1D) cooking pot
73	IK.190.3.4	Phase 2 (1D) cooking pot
74	IK.190.3.5	Phase 2 (1A) cooking pot
75	IK.190.3.6	Phase 2 (1A) cooking pot
76	IK.190.3.7	Phase 2 (1A) cooking pot
77	IK.190.3.8	Phase 2 cooking pot
78	IK.502.1.A	Phase 2 (2D) cooking pot
79	IK.502.1.B	Phase 2 cooking pot
80	IK.502.2.8	Phase 2 cooking pot
81	IK.130.2.4	Phase 2 cooking pot
82	IK.180.1.B	Phase 2 (2A) cooking pot
83	IK.190.2.A	Phase 2 (1A) cooking pot

Iktanu: Intermediate Early Bronze-Middle Bronze Age: kilns

IK100	Area C2	Clay lining of Kiln 1 (Phase 1)
IK101	Area C2	Clay lining of Kiln 1 (Phase 1)
IK102	Area C2	Clay disk 51 (Phase 1)
IK103	Area C2	Clay disk 31 (Phase 1)
IK104	Area C2	Clay disk 9 (Phase 1)
IK109	IK.302.35	Black ash from Kiln IV (Phase 1)
IK110	Area C2	Decayed mud brick near Kiln IV (EB1)
IK111	IK.302.30	Clay lining of Kiln III (Phase 1)
IK112	Area C2	Marl lump in disk 28 (Phase 1)
IK113	Area A10	Clay sample from gravel soils
IK114		Clay sample from gravel soils
IK115	Main tell	Marl sample from highway cutting

Pottery from Phase 1 kilns

IK121	IK.301.+.(a)	pink sherd
IK122	IK.301.+.(a)	pink sherd
IK123	IK.301.+.(b)	pink sherd
IK124	IK.301.+.(c)	pink sherd
IK125	IK.301.+.(c)	pink sherd
IK126	IK.301.+.(d)	very hard red sherd
IK127	IK.301.+.(e)	pink storage bowl
IK128	IK.301.+.(f)	pink sherd
IK129	IK.301.+.(g)	pink sherd
IK130	IK.301.+.(h)	pink sherd
IK131	IK.301.+.(a)	gy/gn misfired sherd
IK132	IK.301.+.(b)	gy/gn misfired jar base

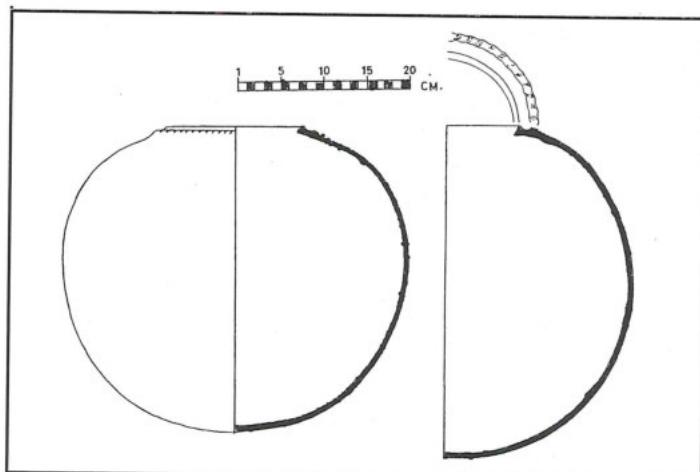
IK133	IK.301.+.(c)	gy/gn misfired jar
IK134	IK.301.+.(d)	gy/gn misfired jar
IK135	IK.301.+.(e)	gy/gn misfired jar
IK136	IK.301.+.(e)	gy/gn misfired jar
IK137	IK.301.+.(f)	gy/gn misfired jar (gy = grey; gn = green) (IK.132 - IK.137 may be part of the same jar)

In the meantime a series of kilns had been excavated at Iktanu in December, 1987 and Newton began a project to analyse the clays used in the kilns, in pottery made in the kiln area, and in samples collected in 1987/1989 from local clay beds. A third sample of 34 analyses has been completed, and all the results are in TABLE 2. The interpretation is not complete, but the following preliminary remarks may be of interest to colleagues.

The cooking pots used in the late third millennium village at Tall Iktanu are round-based, globular hole-mouth jars. The holemouth rim and the calcite temper are made in the classic Early Bronze Age tradition, used by potters throughout Palestine for the previous millennium. They are characterised by crushed quartz and calcite temper. The walls are surprisingly thin, at Iktanu usually 5-6 mm thick, for vessels which are usually large, like the intact examples found at Wādi ad-Dāliyah on the West Bank which are respectively 40 and 50 cm in diameter (Lapp 1974: 40-42, PL. I:5, 7; see FIG. 1). They are well made, and coil-built, perhaps with the help of moulds. There are, however, changes in manufacture and typology between Early Bronze 3 and the Intermediate Early Bronze-Middle Bronze Age (=EB 4) and it is usually possible to distinguish sherds of the two periods, as Lapp also pointed out. In the Iktanu area also, EB 3 cooking pots seem to have flat bases, which are never found in the EB.MB period cooking pots at Iktanu. This seems to mark a social change between the two periods.

The EB.MB village at Iktanu had two structural phases with a brief period of abandonment between them; both phases were relatively short. Although there is clear continuity between the phases, there are also numerous changes. The ceramic repertoire, although consisting of basically the same range of equipment in both phases, is also distinguishable. Holemouth cooking pots are in use in both phases, but a higher proportion of undecorated pots with concave rims (Type 1A) seems to occur in Phase 1, and cooking pots with a flat or convex rim and a band of impressed decoration below the rim (Type 2D, see FIG. 1) seem to be more popular in Phase 2 (Prag 1974: 83, FIGS. 3:17, 18; 6:5, 6; Prag 1988: 69, FIG. 6:7, 8).

Apart from 'fingerprinting' the local ceramic production, it was thought that the investigation of the cooking pots might help to resolve the question of whether the changes are due simply to passage of time between



1. Two EB.MB cooking pots from Wādi ad-Dāliyah (from Lapp 1974).

Phase 1 and 2 at the site, or whether some change of population is represented between the two settlements. If the Phase 2 population exploited a different clay bed we might assume discontinuity in local traditions (forgotten local resources, or different traditions); on the other hand exhaustion of a previous clay bed might be involved, or the discovery of a more workable or better clay.

Chemical Analysis

Chemical analysis using neutron activation has been used on the samples listed in TABLE 1. The purpose was to identify different groupings and see if this was related to vessel type or find location; in addition clay analyses were included in a preliminary attempt to relate the pottery to a clay source.

Sample Preparation

For the pottery the surface of sherds was cleaned with a flat diamond drill and a sample drilled with a pointed diamond drill from the cleaned surface. 200mg of this sample was weighed precisely.

For clay an attempt was made to follow the routine potters may have used. Large samples of several kilograms were taken from various positions in the clay bed; these were then slurried with water and after a few minutes poured off into clean vessels to separate the coarse material which was left behind. Each sample was allowed to settle for about 12 hours and then the very fine particles and organic matter decanted from the surface. The remaining sludge was allowed to dry in the sun until plastic. Several small tiles (about 5 x 5 x 0.5 cm) were made from each sample and the sample number drawn in the wet clay, these were then dried completely in the sun. 200mg samples were taken from each tile by grinding a portion to a fine powder in an agate mortar and pestle.

Irradiation

To optimise provenance it was necessary to measure as many elements as possible, in this case 22. This requires three separate irradiation steps:

- a) 10 minutes irradiation, 10 minutes decay and 10 minutes counting; this measures Na, Al, Ca, Ti, V, Mn, Dy and U.
- b) 10 minutes irradiation, 2 - 3 hours decay and 20 minutes counting; this measures Na, Mn, Dy and Sm.
- c) 7 hours irradiation, 7 - 14 days decay and 2 hours counting; this measures Sc, Cr, Fe, Co, Rb, Sb, Cs, La, Ce, Eu, Sm, Yb, Lu, Hf, Ta and Pa.

All irradiations were at the Universities Reactor, Risley; the 10 minute irradiations in the fast rabbit and the 7 hour irradiations in the 4 x 4 inch hole.

Analysis

The Manchester standard (Podmore Red Clay, analysed by ten different laboratories around the world) was irradiated with every eight samples. Quantitative results were obtained using standard gamma ray spectroscopy and taking the ratio of peak areas between sample and standard for each element. Since the concentration of each element in the standard is well known, the concentration in the sample could be calculated. The results are in TABLE 2.

Interpretation

It is difficult, if not impossible, to identify groups by visual inspection of such a large dataset as TABLE 2. Various statistical techniques are available to facilitate group classification and Ward's method of clustering has been used here. This procedure has suggested eight groups:

- Group 1. (40 samples) IK10, IK12, IK14, IK16-20, IK26, IK27, IK109-111, IK115, 4, 11, 14, 19-32, 51, 61-63, 66, 73, 80, 81, 83.
- Group 2. (24 samples) 1-3, 5, 6, 8, 15, 18, 50, 52, 54-60, 64, 65, 67, 71, 72, 76, 82.
- Group 3. (10 samples) 7, 8, 10, 12, 68-70, 77-79.
- Group 4. (9 samples) IK4-9, IK11, IK13, IK15.
- Group 5. (6 samples) 13, 16, 17, 53, 74, 75.
- Group 6. (16 samples) IK1-3, IK12, IK20-30, IK115.
- Group 7. (9 samples) IK100-104, IK112-114, IK130.
- Group 8. (14 samples) IK121-127, IK129, IK132-137.

Discussion

(which includes additional material submitted by H. J. Franken for analysis).

Group 1 is very heterogeneous and includes two groups of fine calcite wares from Jericho and Jerusalem, and five examples each of Iktanu Phase 1 and of Phase 2 cooking pots. The distinction between Groups 1 to 6 is not clear, and the possibility of three separate types of calcite clay in Groups 1, 4 and 6 needs confirmation.

Group 2 consists mainly of Phase 1 cooking pots, Group 3 is uniquely Iktanu Phase 2 cooking pots. Of the twenty-four Phase 1 cooking pots sampled, seventeen are in Group 2, the remainder are in the heterogeneous Group 1 except for one in Group 5. Of the twenty-two Phase 2 cooking pots, ten form a unique Group 3, with the remainder scattered in Groups 1, 2, and 5. There is no obvious archaeological solution to the variation; the sherds derive from a number of different contexts. However the site is shallow, and allowance should be made for some Phase 1 residuals in Phase 2, and for rodent activity. The student projects suggested that the majority of Phase 1 examples in Group 2 indicated a clay distinct from that used in Group 3. The second project included a correction program for dilution by calcium carbonate (CaCO_3) on all 66 samples and concluded that the groups were distinct, but more work is needed on interpreting these samples.

Groups 4 and 6 are uniquely fine calcite ware of various sites and periods, but the groups appear to be differ-

ent; it remains to be seen if the only difference is one of dilution with varying amounts of calcite for example.

Groups 7 and 8 are discrete, and these should be separated from the dataset with the remainder being re-interpreted. Group 7 consists of two groups of samples, clays taken from the red gravels on the south hill at Iktanu, and clays used in the Phase 1 kilns on the south hill (linings and disks, see Prag 1988: FIGS. 2-4). This implies that the latter were made from the local clays on the South hill, which are certainly not the same as the geologically distinct deposit of marl clay from the north tell, only two samples of which have been analysed to date, and which appear in Groups 1 and 6. Much more work is planned on these clays.

Group 8 consists entirely of pottery from the Phase 1 kiln area for which there is no local clay identified as yet. The possibility that the analysis of the clay used in this group is affected by use of grog temper has also to be investigated.

Table 2. Neutron activation results (Elements: Na%, Al%, K%, Ca%, Sc, Ti%, V, Cr, Mn, Fe%, Co, Rb, Cs, La, Ce, Sm, Dy, Yb, Lu, Hf, Th, U). Results expressed in ppm unless shown otherwise.

1	8265	5.4000	1.3400	14.9000	9.4970	.4803
	91.0000	89.8022	156.6000	5.2277	9.4275	44.5958
	17.6602	23.7526	54.8644	7.1102	4.2600	.6705
	.3885	7.7005	5.6528	1.0146		
2	.5954	4.8900	1.7400	12.6000	11.0598	.4467
	83.3000	100.6400	190.6000	4.7522	13.2330	59.5223
	14.8209	24.7415	53.4884	8.3531	3.0400	.6740
	.4083	8.0049	6.1870	2.2459		
3	.6139	5.3850	1.3120	10.7000	10.7303	.5117
	106.3000	96.1807	144.0000	4.5556	12.2028	57.0763
	21.2385	23.8335	51.0724	6.0251	3.2600	.5879
	.3470	7.3398	5.7861	1.3600		
4	.5922	4.5000	1.5000	13.0000	8.4373	.4435
	65.4000	81.0597	164.0000	3.1667	7.7965	38.8374
	14.9046	20.3435	44.6517	4.9143	2.8400	.5571
	.3352	6.6063	4.8945	10.1286		
5	.6711	5.6000	1.8500	10.2000	10.4016	.4934
	87.6000	92.6936	150.0000	4.4757	10.0552	56.7770
	15.7644	22.2939	49.9562	5.9739	3.3600	.6041
	.3536	7.1478	5.7506	1.3873		
6	.6529	5.0000	1.5000	11.8000	10.5195	.4911
	73.0000	94.5264	124.0000	4.3308	8.8812	60.6031
	17.9664	24.3180	49.1025	5.8235	2.8900	.6023
	.3295	8.2778	6.0168	1.3282		
7	.2570	4.0800	1.2500	16.9000	8.1707	.2940

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	96.8000	67.6310	2054.000	2.8061	13.3779	27.9029
	2.7404	18.6563	37.6067	5.9833	1.8900	.5023
	.3422	5.8807	4.3709	2.1891		
8	.6655	5.5200	1.4400	15.3000	11.8218	.3943
	82.7000	105.0241	252.0000	4.7826	15.6033	51.0385
	12.0065	27.2010	54.2715	8.7519	2.9600	.6997
	.4169	6.0958	5.9941	2.2339		
9	.3701	4.2000	1.0800	20.0000	8.1348	.3281
	75.9000	75.2097	1267.0000	3.0455	12.2501	27.6911
	3.7783	18.6590	40.1831	4.9536	2.3000	.3946
	.3124	4.7468	4.2865	3.0987		
10	.5508	3.8900	2.1300	20.7000	7.5645	.3049
	98.4000	57.7876	1772.0000	2.8793	10.8163	26.9602
	2.7396	17.8661	36.2271	5.7037	3.4900	.4171
	.2966	4.1480	3.9529	2.3425		
11	.4638	7.2500	1.7000	16.5000	10.6448	.4507
	87.0000	92.8475	496.0000	3.1534	15.3393	25.8037
	1.7006	23.4176	47.9871	5.8790	2.8300	.5762
	.3402	6.2172	5.2798	2.0168		
12	.2473	4.2500	1.5100	19.6000	8.9008	.3240
	75.9000	74.7637	1459.0000	2.9687	14.0794	31.7850
	3.0814	21.3669	41.3792	6.4106	2.2500	.5357
	.2918	5.7697	4.9010	2.4347		
13	.4698	8.5300	2.2700	7.6300	15.7496	.6068
	93.3000	110.9699	384.0000	5.1350	24.3992	75.7487
	7.2331	44.1594	91.7088	12.1311	2.9400	1.1362
	.5936	9.4916	9.6109	3.1170		
14	.4675	5.0300	.6585	16.0000	9.5954	.2944
	71.3000	63.1591	338.0000	2.8673	14.9144	18.8761
	3.8971	17.7358	37.2184	5.6903	2.2500	.4513
	.3147	5.5414	4.4531	3.0658		
15	.6874	7.6000	1.8200	8.2000	13.1923	.4506
	94.0000	97.6751	183.0000	2.9296	12.1672	63.3657
	10.1389	26.3885	52.1566	4.9435	2.5000	.4972
	.3140	6.0320	7.3574	1.4856		
16	.8335	9.7100	2.7500	7.5400	15.8394	.6002
	90.3000	142.7844	244.0000	5.1736	15.5636	80.2324
	7.5175	54.6461	110.9059	8.6905	5.0600	1.1046
	.6412	10.5522	11.6272	2.9283		
17	.4677	8.1400	2.0900	8.9200	14.7981	.5435
	95.4000	99.6157	334.0000	4.5994	17.8157	.8887
	6.5253	40.6639	84.8641	12.0926	5.0800	.9585
	.5677	9.8141	9.2377	3.4484		
18	.6014	6.9100	2.1200	7.7300	13.2185	.4373

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	88.7000	115.3853	182.0000	2.8241	15.8981	73.7298
	9.0728	29.1172	59.4609	7.7821	2.4100	.6907
	.4357	7.9656	8.0068	3.1399		
19	.6353	5.2000	2.2000	13.2000	10.5137	.4819
	92.0000	113.7537	253.0000	2.9321	14.3215	36.0265
	3.3324	27.0150	55.4335	6.8442	3.5000	.6385
	.3981	6.2928	5.5009	2.3944		
20	.3460	3.8300	1.4500	22.9000	8.5579	.2840
	76.3000	159.5052	275.0000	2.2903	9.2608	15.5199
	1.6097	30.0619	45.1107	7.0400	3.5700	.7944
	.6019	3.1529	3.5208	7.4103		
21	.4945	5.1200	2.4600	20.4000	9.6799	.2192
	71.3000	65.6899	122.2000	2.3114	6.6942	42.5064
	3.3911	13.8901	26.0366	3.5999	2.0300	.4225
	.2238	2.4122	3.4865	1.1813		
22	.5681	4.3500	3.5700	14.7000	11.5752	.2751
	82.6000	83.1511	229.0000	2.3357	13.0368	62.2855
	5.0529	18.3762	36.3986	6.2877	2.6000	.4224
	.3188	3.5222	4.5945	2.0622		
23	.2742	6.4800	3.3800	12.9000	13.8086	.3028
	105.0000	92.1856	199.0000	3.2574	16.0433	71.5979
	8.0704	18.5049	39.1482	6.5247	2.2700	.5478
	.3518	3.5319	4.8489	2.6501		
24	.3902	6.8700	4.6400	13.0000	12.8561	.2815
	98.0000	88.2194	256.0000	2.9482	17.2694	75.4582
	7.9178	15.7310	35.5006	4.5709	2.2900	.3971
	.2965	3.0315	4.3687	2.7056		
25	.4878	4.0300	1.8300	18.8000	8.2369	.3361
	93.6000	115.5184	498.0000	2.5118	12.2874	29.1713
	2.9205	22.3670	45.8010	5.7241	3.0000	.5651
	.3989	5.5380	4.0846	3.9164		
26	.8112	4.2700	1.8600	17.0400	8.5301	.3595
	88.8000	126.0335	488.0000	2.5199	11.4233	31.0569
	2.6833	23.6511	45.2731	5.9644	2.8200	.5775
	.4279	4.7113	4.3493	4.3145		
27	.6144	6.0600	1.0300	17.3000	14.2621	.3352
	126.0000	95.6646	444.0000	3.0118	17.1551	36.4065
	4.7315	44.5549	61.0628	8.0353	5.4000	1.3299
	.8944	5.0886	6.0542	6.2200		
28	.1956	9.5000	2.1400	7.0000	15.4038	.4553
	68.3000	107.1398	206.0000	3.8366	14.2589	43.7378
	5.3149	16.9491	38.9136	5.2967	2.8300	.5218
	.3087	3.5729	5.8088	3.2179		

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29	.1596	8.7400	2.8000	8.7700	17.8271	.4652
	84.4000	117.3270	227.0000	3.9309	17.6863	37.8626
	1.2883	25.2116	54.8708	9.1069	3.4400	.6589
	.4231	5.2994	6.6811	3.6400		
30	.2525	5.9700	2.2300	16.0400	12.5636	.3194
	76.3000	84.8466	208.0000	2.7425	11.4324	54.5573
	5.4467	20.0052	39.5302	6.7556	2.2600	.4668
	.3083	3.9582	4.8404	2.7911		
31	.9970	6.7300	2.0000	12.9000	13.3248	.3301
	90.5000	85.5485	158.0000	3.4582	10.3656	49.6995
	6.3714	16.2765	34.9646	5.8226	2.1600	.4456
	.3044	3.4250	4.8700	2.4013		
32	.2915	5.9200	3.2300	14.4000	11.0962	.2627
	85.5000	68.9296	174.0000	2.5635	10.4479	52.4604
	4.8919	14.3730	33.3917	4.0750	2.1800	.4265
	.2462	2.4304	3.8831	1.9167		
50	.7231	5.4600	1.0600	14.6000	10.4505	.4513
	79.5000	88.8200	135.0000	4.0835	10.3225	50.7353
	16.1387	24.4807	62.7729	7.8851	4.4200	.7429
	.4214	6.7747	5.6483	1.4756		
51	.5736	5.9400	1.6200	19.6000	10.6092	.2927
	83.2000	63.4942	167.0000	2.5589	8.7123	35.1200
	3.2218	13.2113	31.6427	3.8717	1.9100	.3992
	.2449	2.2590	4.0316	1.1679		
52	.5550	4.2000	.7310	15.3000	9.8045	.4031
	70.1000	90.7658	163.0000	5.4073	13.0584	70.0613
	21.6046	22.3932	52.0872	6.0227	2.5000	.7080
	.3796	7.6071	5.5844	1.3567		
53	.8196	7.7100	1.5600	12.3000	12.6160	.4553
	78.5000	78.2004	277.0000	4.1421	12.5409	46.5973
	3.7645	37.8037	88.0448	88.5551	4.4500	.9411
	.5140	7.9533	8.8018	2.9185		
54	.7717	5.2200	1.1000	10.8000	11.7184	.4797
	77.9000	99.1928	148.0000	5.4653	10.8363	50.4794
	14.4102	26.7187	71.6039	8.4920	4.2900	.9499
	.4754	8.9920	6.6202	1.5376		
55	.5943	4.9000	1.1600	11.8000	10.9150	.4201
	77.0000	97.4134	127.0000	4.2943	9.1046	66.7658
	21.6278	23.2205	53.6194	5.8870	2.6700	.6591
	.3377	8.0735	6.1507	1.5170		
56	.6358	5.2300	1.4200	12.3000	10.5731	.4331
	97.7000	88.7541	153.0000	3.9036	13.6330	52.5958
	14.6309	21.5986	51.9624	5.6018	2.6200	.6708
	.3618	6.5908	6.2347	1.9685		

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57	.6124	4.6800	.7640	14.4000	9.6833	.4332
	74.7000	92.1409	138.0000	3.2664	9.0684	51.0796
	13.7636	20.3141	50.0056	5.5308	2.6000	.5941
	.3334	6.5236	5.4323	1.8726		
58	.1560	6.3000	2.2300	19.9000	11.5250	.6515
	107.0000	102.3740	307.0000	4.8513	10.9374	67.2640
	16.4775	24.2611	59.5177	6.6411	5.3000	.7563
	.4088	7.4502	5.9665	1.5464		
59	.6037	4.4000	1.2200	11.3000	9.9721	.3840
	68.4000	91.6266	154.0000	4.2026	11.9122	51.8130
	11.8402	22.5789	55.6442	6.1924	2.4300	.7128
	.3961	9.1342	6.0570	1.3156		
60	.8131	5.1700	.5100	9.6100	11.8698	.4415
	77.2000	102.9170	140.0000	5.5031	10.9251	52.7242
	14.8396	26.2566	69.9220	8.3145	3.4200	.8625
	.4644	8.3668	6.8263	1.6164		
61	.4790	5.2000	1.7500	19.1000	8.5455	.4193
	74.0000	78.9561	237.0000	2.4171	10.5079	38.2355
	9.8305	18.6479	44.7942	4.9412	2.3700	.5864
	.3175	6.1771	5.1850	1.8503		
62	.6329	5.8600	1.6700	19.1000	11.3550	.3148
	77.8000	70.4383	162.0000	2.7042	8.6783	34.4628
	3.1201	15.3491	34.8515	4.4760	2.0900	.4569
	.2555	2.7533	4.3876	2.2885		
63	.5471	8.5000	1.0700	24.5000	11.4524	.2990
	97.1000	76.6084	157.0000	2.6754	9.9472	35.3415
	3.9656	15.2475	35.4222	4.2949	1.5400	.4548
	.2457	2.4641	4.5609	1.3008		
64	.5590	1.6900	.8510	12.1000	9.1750	.2798
	38.0000	84.7107	171.0000	3.6172	11.1291	64.1068
	17.1303	21.4162	49.2889	5.5781	3.0700	.6006
	.3302	6.1984	5.2276	1.3745		
65	.6439	4.7900	.7340	17.1000	9.7103	.4116
	67.5000	91.0893	169.0000	3.7831	10.3653	56.7744
	18.5620	22.1796	50.6276	5.7320	2.8200	.6579
	.3573	6.3377	5.5273	1.6462		
66	.7864	5.6000	1.7200	16.4000	6.9096	.5308
	90.0000	68.1689	225.0000	3.5561	9.9982	36.3605
	8.4635	16.9740	37.7916	4.5001	3.6500	.4854
	.3153	5.2971	4.2010	2.2844		
67	.5076	3.2800	.7320	19.2600	9.6550	.3039
	67.3000	90.9373	236.0000	3.8672	9.9063	51.4323
	14.4919	20.9301	49.4795	5.5756	2.1000	.5862

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68	.3339	6.9601	5.4139	1.5921		
	.3702	4.3500	.9200	21.3000	8.5103	.2994
	83.1000	73.8699	1389.0000	2.8699	12.2725	27.1305
	3.9770	20.6995	42.2967	5.1831	2.0700	.5077
	.3289	5.2075	4.8160	2.9110		
69	.1943	4.1300	.8800	19.8000	8.0949	.3083
	78.4000	65.4409	1571.0000	2.5125	11.1589	25.8219
	2.9617	18.5700	40.4555	4.7663	2.8000	.4209
	.2896	4.2120	4.2420	1.9630		
70	.2593	4.8400	1.4400	18.1000	9.8606	.4208
	84.9000	88.0955	2056.0000	3.2290	14.4656	33.6365
	3.1663	24.8869	52.2304	6.0348	2.6100	.5772
	.3771	5.7236	5.1850	2.5120		
71	.5134	5.1600	1.5600	9.6300	10.9773	.4826
	80.3000	92.8841	251.0000	4.4304	14.5341	51.6552
	14.1850	21.9165	52.1186	6.0263	3.2800	.6180
	.3904	9.6079	5.9290	1.4400		
72	.6167	4.4700	1.1400	10.3000	9.4306	.4888
	67.0000	85.9350	161.0000	4.3415	11.3093	38.3466
	13.4309	18.1040	47.3492	5.2784	3.2200	.5143
	.3483	9.8631	6.0900	1.3970		
73	.6551	4.6400	1.5100	19.2000	9.1377	.3550
	67.3000	72.4154	432.0000	2.5900	13.3316	32.3989
	3.8945	19.2965	42.9888	5.1475	2.8300	.4534
	.3085	6.1539	4.8750	2.1330		
74	.5288	6.8200	1.6600	14.7000	10.7437	.3878
	56.9000	67.1549	368.0000	3.6432	14.7146	47.9021
	4.2203	36.7593	81.3771	8.5409	4.2700	.8472
	.5098	8.6033	8.3770	2.7210		
75	.5935	7.3500	1.5000	12.5000	11.9260	.7433
	69.7000	73.8491	382.0000	4.1074	16.3823	44.2568
	5.0226	37.6591	85.8309	9.1592	4.6500	.9308
	.5089	9.1446	9.0180	2.4260		
76	.3552	4.6700	1.2900	13.1000	10.1391	.6165
	73.9000	90.6176	224.0000	4.2646	12.5373	51.7363
	17.1283	23.9546	52.2972	6.1347	2.9500	.6012
	.3592	7.0689	5.6400	1.3450		
77	.9758	5.1700	1.4800	17.4000	10.6769	.4087
	93.2000	91.7220	1551.0000	3.4737	16.2711	26.8242
	3.2408	24.8439	53.1774	6.3980	2.5300	.5353
	.3464	5.4295	5.6340	2.7310		
78	.2180	4.5600	.9670	17.5000	9.3950	.4432
	77.2000	76.8657	1641.0000	3.1497	13.4156	33.3079
	4.4196	21.3597	44.8446	5.4331	2.2000	.4974

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79	.3065 .1961 87.6000 4.6197 .3613	5.0233 4.6100 86.1916 21.9628 5.7049	5.1400 .9130 1605.0000 47.8921 5.1470	2.1760 16.0000 3.3864 5.7504 2.8060	9.7095 15.4534 2.4200 .5130 34.3809	.5272
80	.3308 102.0000 5.5094 .3938	6.9800 123.7357 26.0256 7.2857	1.4700 556.0000 55.5135 6.2240	12.3000 4.0905 6.8155 2.8930	14.1345 19.3766 3.2400 .6701	.7048 41.8411 .6701
81	.5605 88.8000 5.2467 .4426	5.8000 100.5970 26.6659 7.6978	1.1300 589.0000 58.6260 6.1880	14.7000 3.6849 6.9933 2.1240	12.2537 17.3489 3.1700 .4317	.4317 36.0823 .7056
82	.2546 76.7000 19.5689 .3641	5.2300 98.0902 24.8739 7.0029	1.1600 178.0000 52.9088 5.9900	12.8000 5.2807 6.3529 1.4960	11.2351 10.8122 3.0000 .4354	.4354 62.5925 .6519
83	.2060 51.5000 3.3095 .3501	5.2600 58.4508 25.3450 5.5730	1.1200 307.0000 54.0507 5.7160	18.4000 2.5081 6.0071 2.0630	8.3916 11.6084 3.1200 .3140	.3140 31.8919 .5509
IK100	0.9523 31.0000 0.3638 0.2215	2.2500 119.7299 14.6088 6.1103	1.4800 361.0000 28.4551 2.9394	21.2000 1.3730 3.6109 1.7900	4.2924 8.6788 1.6300 .1193	.1193 7.6241 0.3092
IK100	0.9523 31.0000 0.7294 0.2604	2.2500 46.0269 13.7194 6.4688	1.4800 361.0000 29.3185 3.1444	21.2000 1.4341 3.7993 1.7900	4.4165 9.4235 1.6300 .1193	.1193 8.9515 0.5213
IK101	0.5580 77.1000 1.9931 0.2387	3.8900 46.4845 14.9408 5.6865	1.5600 363.0000 29.0436 3.1459	25.2000 1.5381 3.6954 3.0300	4.6871 8.9562 2.8500 .2220	.2220 22.6709 0.3376
IK101	0.5580 77.1000 2.4346 0.2549	3.8900 49.9110 15.7870 6.5400	1.5600 363.0000 31.7971 3.6445	25.2000 1.7350 4.0862 3.0300	5.3219 8.9154 2.8500 .2220	.2220 27.1697 0.3215
IK102	0.6776 61.5000 2.2194 0.2016	2.6300 41.1809 11.3629 3.0085	1.7500 220.0000 25.1221 2.7508	27.9000 1.4456 3.3749 2.0500	4.7827 7.4511 1.2400 .1166	.1166 22.3004 0.3415
IK102	0.7104 55.5000 2.1248	2.6000 43.1709 11.6287	1.5700 213.0000 25.7533	27.1900 1.4655 3.6008	4.8425 6.8051 1.6400	.1245 19.9814 0.2315

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IK103	0.2003	3.4552	2.7398	2.1400		
	0.7378	3.0300	1.5300	28.6000	5.0542	.1409
	59.9000	45.3534	217.0000	1.4743	8.0481	12.6089
	1.9547	14.6183	26.0747	3.5491	1.4900	0.2498
	0.2367	3.2973	2.7220	3.2900		
IK104	0.4926	2.7000	1.5400	27.9000	5.1174	.1130
	44.9000	40.5192	214.0000	1.5062	7.5922	29.2790
	2.8618	13.4235	27.4084	3.6523	1.7200	0.2600
	0.2227	3.7304	2.7602	2.4700		
IK104	0.5000	2.8900	1.6100	28.6000	5.1371	.1211
	51.0000	43.4630	219.0000	1.4618	7.5776	26.8352
	2.9637	12.3586	26.0022	3.7409	1.3600	0.3398
	0.2117	2.9721	2.8226	2.5100		
IK109	0.7342	2.6100	1.6600	16.8000	8.1729	.1667
	42.0000	96.3541	366.0000	2.5888	15.6477	29.7448
	2.7383	26.2210	52.1706	11.9959	2.3000	0.7262
	0.4430	11.7139	6.7045	2.7600		
IK110	0.4619	3.3800	1.3400	18.5000	6.5834	.1830
	63.0000	68.7120	372.0000	2.0521	10.8521	25.9373
	2.1095	19.0570	38.7822	8.8739	2.4000	0.4747
	0.3023	8.4475	4.6013	2.5300		
IK111	0.6794	2.3200	1.4600	18.9000	4.9572	.1783
	51.4000	54.0722	281.0000	1.5929	9.0921	13.9886
	0.9886	14.8412	29.3937	7.0040	2.0100	0.3915
	0.2653	6.9801	3.6156	3.2200		
IK111	0.6509	2.4300	1.4200	19.5000	8.1387	.1423
	53.1000	84.3178	286.0000	2.5656	14.9976	24.5250
	1.3013	25.0838	52.0774	11.5931	2.4900	0.5893
	0.4066	10.4330	5.7476	3.0300		
IK112	0.5586	2.8800	1.5200	26.0000	41.2208	.1200
	49.0000	1.2875	201.0000	6.7566	22.2841	2.9837
	12.1524	25.7793	3.2010	0.8100	2.0500	0.2117
	3.0783	2.7507	1.9661	1.7000		
IK112	0.6098	3.6500	1.4200	24.9000	43.8738	.1439
	52.0000	1.0904	184.0000	5.3462	27.8597	4.5944
	12.7196	25.3173	3.0003	0.8913	1.6700	0.2147
	2.6358	2.8864	1.8621	2.9500		
IK113	0.0353	1.3510	1.5300	75.9400	1.2702	.0308
	35.2000	25.3442	196.0000	0.3243	1.7772	5.3925
	0.4807	7.8670	6.1661	1.8220	1.4970	0.1101
	0.0804	0.3351	0.4541	3.3520		
IK113	0.0353	1.3510	1.5300	75.9400	1.9177	.0308
	35.2000	50.8928	196.0000	0.4871	3.8704	3.9808
	0.5975	8.0043	9.5519	2.1958	1.4970	0.2244

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	0.1145	0.5548	0.7204	3.3520		
IK113	0.0252	1.2840	1.4400	72.7000	1.9044	.0340
	34.7000	35.2234	189.0000	0.5088	3.3743	5.2058
	0.5095	7.4891	10.1376	2.1049	0.9510	0.1514
	0.1249	0.5915	0.7344	2.1010		
IK114	0.0423	2.0350	1.3300	65.1900	2.2113	.0874
	53.5000	38.8140	181.0000	0.7614	4.9027	5.5343
	0.1511	9.7147	12.9895	2.7589	0.6800	0.1742
	0.1541	1.8524	1.1152	3.3080		
IK114	0.0477	2.0320	1.3900	65.6000	2.2783	.0786
	55.4000	40.4542	180.0000	0.8296	4.8005	5.1468
	0.4142	11.2123	13.1919	2.9697	1.3530	0.1749
	0.1796	2.2341	1.1770	2.9840		
IK115	0.8033	8.7400	1.7800	41.5800	8.2284	.2220
	105.0000	78.7099	327.0000	2.3893	12.8699	41.5666
	2.5182	21.5706	37.8256	5.6811	1.3470	0.4566
	0.3132	4.0646	4.2416	4.8240		
IK115	0.0860	7.1870	0.6380	2.4960	9.0084	.4617
	122.0000	77.6208	525.0000	2.5247	13.2302	30.6275
	1.2083	19.8443	41.9591	10.6192	6.4940	0.5197
	0.4298	4.4065	4.5225	4.3300		
IK121	0.7999	10.7000	1.4000	3.7600	112.8140	.4536
	141.0000	4.4217	272.0000	16.2561	49.8133	6.7212
	54.9540	122.8088	12.0070	2.9864	6.0600	0.7044
	10.7269	12.5871	5.0859	5.2800		
IK122	0.7872	9.8640	1.5600	3.4230	153.4001	.4473
	131.0000	4.6483	228.0000	14.9834	56.5244	5.6347
	64.4213	124.7854	13.0331	2.6846	7.2150	0.6813
	11.1044	13.3775	5.5267	5.8010		
IK123	0.8192	10.4000	1.8400	2.6300	110.1822	.5014
	133.0000	4.2736	207.0000	14.1891	41.4481	3.5712
	52.3754	115.0142	11.6892	2.5397	7.0600	0.7023
	10.5236	12.5826	4.6732	4.9300		
IK124	0.8325	10.3000	1.7400	4.1400	111.2071	.4699
	138.0000	4.1445	219.0000	13.3447	49.7191	4.2969
	55.4469	111.6415	11.6260	2.6331	6.1500	0.6614
	10.2919	12.3664	4.9804	4.6000		
IK126	1.5800	12.5000	3.0300	2.1000	124.6681	.6514
	107.0000	6.8953	1192.0000	24.7517	78.0456	8.3986
	59.9388	132.8352	12.9948	2.9056	13.0000	0.7759
	13.0818	13.0139	3.0295	6.2900		
IK127	1.6700	8.9300	2.9500	12.3000	96.8913	.5007
	112.0000	4.1835	901.0000	19.8128	51.2539	5.3521

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	40.9338	91.8114	9.4121	2.0800	10.0000	0.6188
	8.5499	9.5205	3.1173	7.8900		
IK125	0.6928	10.3000	1.7300	2.9800	113.0573	.4887
	129.0000	4.3107	207.0000	12.0637	38.6360	4.4508
	53.2770	116.9757	11.7914	2.6703	5.4400	0.6995
	10.6734	12.2667	5.3059	3.9700		
IK129	0.7658	10.0000	1.6900	4.0500	128.2802	.5008
	157.0000	4.2687	202.0000	12.9161	49.8964	4.3561
	46.6938	105.6789	10.5467	2.8419	4.8800	0.6460
	10.0189	11.9807	4.6290	5.1300		
IK130	1.0000	5.3400	2.2100	12.1000	85.6999	.2024
	99.8000	2.8203	225.0000	10.9341	57.3285	4.2684
	19.3810	45.1035	4.5953	2.8857	2.7800	0.2503
	4.4017	4.8455	1.5781	3.6800		
IK132	0.6408	10.6000	1.4500	3.8900	136.9720	.4945
	144.0000	4.8794	254.0000	14.3375	66.0225	8.9489
	61.2234	130.0962	13.5470	2.8101	6.9400	0.8533
	12.9151	13.8792	7.3768	7.8100		
IK133	0.4892	10.9000	1.2800	4.2900	127.7854	.4834
	147.0000	4.3843	191.0000	10.8679	68.1514	8.4370
	62.0213	129.8006	12.5531	2.2880	5.6300	0.7765
	12.4608	13.9646	7.6968	7.5100		
IK134	0.7137	8.9640	1.4560	6.1930	111.8730	.4017
	118.0000	4.3076	298.0000	14.5853	69.7726	7.1477
	48.2094	104.0424	11.3713	1.8239	5.8230	0.6672
	10.5516	11.2687	5.0417	5.8800		
IK135	0.6395	10.5700	1.3390	3.9730	3.9300	.5376
	101.0000	6.0273	584.0000	22.9931	70.6427	7.6078
	54.3214	115.5282	11.7004	2.0131	6.8320	0.7221
	11.2178	12.2401	3.0996	3.9300		
IK136	0.7225	10.0200	1.4150	5.1120	104.3742	.4585
	108.0000	5.6996	568.0000	23.6292	70.0229	5.7191
	50.5834	110.3026	11.0029	2.0449	6.4920	0.6947
	10.8459	11.7410	3.4104	3.3900		
IK137	0.3128	8.7111	0.8310	4.8620	94.3836	.4143
	113.0000	4.1500	202.0000	10.4157	56.9501	6.1941
	54.7225	109.8337	6.8059	1.7571	4.8090	0.6466
	10.5714	11.9290	5.8123	4.9840		

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