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Regional Differences in the Chemical Composition of Cuneiform Clay Tablets

Etsuo Uchida*, Daiki Niikuma, Ryota Watanabe

Department of Resource Engineering, Faculty of Science and Engineering, Waseda University, Tokyo, Japan
Email: *weuchida@waseda.jp

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Abstract

To elucidate regional differences in the chemical composition of cuneiform clay tablets originating from Iraq and Turkey, chemical analysis was conducted using portable X-ray fluorescence analyzers. The analysis included clay tablets from the 21 areas of Ur, Larsa, Lagash, Uruk, Umma, Adab, Drehem, Nippur, Kish, Borsippa, Dilbat, Babylon, Sippar, Nusi, Nimrud, Nineveh, Tell Brak, Tell Halaf, Boghazkoy, Kultepe, and Alalakh, currently stored in the Yale Babylonian Collection at Yale University and the British Museum. Multivariate statistics such as principal component analysis, discriminant analysis, and cluster analysis were applied to the chemical analysis results. Based on the chemical compositions for Ca, K, and Fe, the clay tablets were classified into four groups corresponding to the upper stream area of the Tigris and Euphrates River, the lower stream area of the Tigris and Euphrates River, the northern and central areas in Turkey, and the southern area in Turkey. This grouping was determined mainly by a difference in Ca content dictated by the local geology.

Keywords

Clay Tablet, Mesopotamia, pXRF, Provenance, Multivariate Analysis

1. Introduction

To obtain chemical compositional information to elucidate the provenance of cuneiform clay tablets, we conducted non-destructive chemical analysis of clay tablets originating from Iraq and Turkey. Chemical compositional data were obtained using portable X-ray fluorescence analyzers and multivariate analysis was applied for the obtained data. Chemical analysis data were collected for 540 clay tablets stored in the Yale Babylonian Collection of Yale University (in 2009, 2011, and 2012), and 94 clay tablets including bullae and seals stored in the

*Corresponding author.

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British Museum (in 2013).

Cuneiform clay tablets made during the Mesopotamian period were used as writing media for cuneiform characters. The use of clay tablets dates back to around 3300 BC. A large number of clay tablets were made in the Ur III period (2112 BC to 2004 BC). Economic, administrative, or agricultural information was recorded on the clay tablets. In this research, chemical analysis was conducted on the economic and administrative clay tablets whose information on the provenance was available.

The clay tablets analyzed in this study including bullae and sealings were made in the following 21 areas of Iraq and Turkey: Ur, Larsa, Lagash, Uruk, Umma, Adab, Drehem, Nippur, Kish, Borsippa, Dilbat, Babylon, Sippar, Nusi, Nimrud, Nineveh, Tell Brak, Tell Halaf, Boghazkoy, Kultepe, and Alalakh (**Figure 1**). The clay tablets originated from the Early Dynasty period (2900 BC to 2340 BC) to the Achaemenid period (547 BC to 331 BC). **Table 1** summarizes the provenance, period and sample numbers of the cuneiform clay tablets studied.

Neutron activation analysis has been previously used to analyze clay tablets (Artzy et al., 1976; Dobel et al., 1977; Goren et al., 2009). However, this method is not favorable because the method is destructive. In contrast, a recently developed portable X-ray fluorescence analyzer (pXRF) is non-destructive and quick, with good sensitivity. *In-situ* analysis using pXRF has been applied to the various fields including archaeology and artifacts (e.g., Williams-Thorpe et al., 2008; Cesareo et al., 2008). Chemical compositional analysis of clay tablets using pXRF has been previously performed by Goren et al. (2010), mainly on clay tablets from Egypt and Boghazkoy (Hattusa). In this study, we carried out the chemical analysis of clay tablets from Iraq and Turkey. Clay tablets from Egypt were not analyzed in this research.

2. Analytical Methods

The pXRFs for the chemical analysis of the clay tablets were the pXRF α4000 (Innov-X Systems, Inc., Waltham, MA, USA), used at Yale University in 2009 and 2011, and the pXRF Delta Premium (Innov-X Systems, Inc.), used at Yale University in 2012 and at the British Museum in 2013. Silica and alumina are the major components of clay tablets (Goren et al., 2010). Because the pXRF α4000 cannot analyze these components, analysis was conducted using "Soil Mode" in which the other elements can be analyzed with good precision without measurements of Si and Al. Although the pXRF Delta Premium can analyze Si and Al, the analysis was also conducted using "Soil Mode" to correspond with data collection from the pXRF α4000. Analysis with the pXRF α4000 was conducted in "Leap Mode" for light elements (for 1 min) and in "Standard Mode" for heavy elements (for 1 min). Analysis with the pXRF Delta Premium was conducted using three different filters for 20 s, respectively. Before analysis using both analyzers, calibration was carried out using 10 reference rocks (JA-1, JA-2, JB-1b, JB-2, JB-3, JG-1a, JG-2, JGb-1, JR-1, and JR-2) prepared by the Geological Survey of Japan (Imai et al., 1995). In the pXRF α4000 analysis, calibration showed good precision for the following elements: Ca (3832), K (2294), Fe (2967), Ti (192), Rb (4), Sr (9), Mn (101), and Zn (6). Figures in parentheses are the standard deviation (1σ) (in μg/g) for the calibration of each element. Besides the above elements, Cr, Ni, As, Zr, and Ba were also frequently detected in the clay tablets. Details on the pXRF α4000 analysis were described in Uchida et al. (2011) and Sterba et al. (2011). Calibration of the pXRF Delta Premium was performed using a method similar to that used for the pXRF α4000. Calibration was conducted with good precision for the following

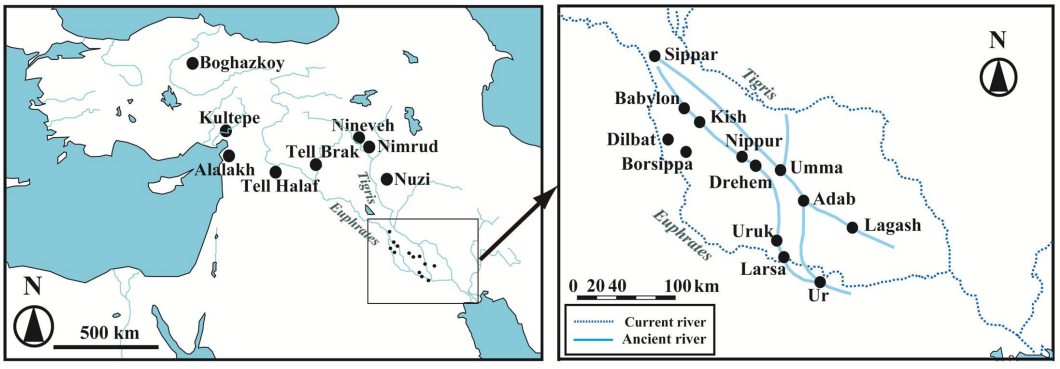

Figure 1. Location map of the areas where the clay tablets investigated in this research originated. Position of the ancient Tigris and Euphrates rivers is taken from Postgate (1992).

Table 1. List of clay tablets studied in this research.

Provenance	Period	Number of samples	Sample nos.
Sippar	OB	17	YBC04319, YBC04328, YBC04329, YBC04346, YBC04580, YBC06816, YBC06972a, YBC06972b, YBC06981, YBC04962, YBC04975, YBC04976, YBC04980, YBC04983, YBC05477, YBC05558, YBC06808
	EAC	15	NBC06134, NBC06173, NBC06136, NBC06169, NBC06165, MLC01667, NBC06231, NBC06240, MLC01779, NBC06184, NBC06208, NBC06153, NBC06244, NBC06237, NBC06189
	NB	5	YBC03542, NBC06154, NBC06120, NBC06113, NBC06128
Nippur	UrIII	12	NBC06646, NBC06696, NBC07628, NBC08507, NBC09928, NBC10061, NBC10384, NBC10537, NBC10540, NBC10583, NBC10784, NBC11305
	NB	15	NBC04717, NBC04755, NBC06119, NBC06138, NBC06179, NBC06186, NBC06200, NBC06226, NBC08377, NBC06398A, YBC09142, YBC09232, YBC09245, YBC09441, YBC09525
	Ishin-Larsa	12	NBC11263, NBC11264, NBC11269, NBC11282, NBC11207, NBC05577, NBC11285, YBC15991, YBC11974, NBC06510, NBC06760, NBC08935
	MB	19	NBC07993, NBC08000, NBC08037, NBC07938, NBC07941, NBC07950, NBC07957A, NBC07961, NBC07964, NBC07965, NBC07966, NBC07949, NBC07962, NBC07976, NBC07991, NBC07935, NBC07956B, NBC07958, NBC08038
	EDIII-OAkk	10	NBC06904, NBC06913, NBC06915, NBC06919, NBC06933, NBC06984, NBC07066, NBC06977, NBC10212, NBC11106
	EAC	10	MLC01663, NBC04664, NBC04761, NBC04777, NBC04781, NBC04782, NBC06133, NBC06229, RBC00273, YBC07048
Drehem	UrIII	30	NBC02204, NBC03611, NBC04219, NBC04236, NBC05074, NBC05083, NBC05597, NBC05607, NBC06563, NBC06683, NBC06690, NBC06692, YBC15751, YBC15763, YBC15904, NBC00142, NBC00144, NBC02494, NCBT01395, NCBT01422, NCBT02347, RBC00420, YBC01582, YBC01589, YBC01590, YBC09825, YBC13472, YBC13674, YBC14224, YBC16845
Adab	UrIII	15	NBC06632, NBC06673, NBC06726, NBC06733, NBC06744, NBC08184, NBC08192, NBC08213, NBC08217, NBC08219, NBC09950, NBC09953, NBC10111, NBC10112, NBC10161
Umma	ED	15	NBC05803, NBC05847, NBC05849, NBC05850, NBC05851, NBC05852, NBC05853, NBC05854, NBC05855, NBC05857, NBC05858, NBC05860, NBC05861, NBC05916, NBC06921
	UrIII	28	YBC15320, YBC15328, YBC15243, NBC03181, YBC14149, YBC14165, YBC14515, YBC14076, YBC14854, YBC14436, YBC14193, YBC04757, NBC03591, MLC02307, YBC04191, NBC535, NBC577, MLC1103, MLC1113, NBC657, NBC678, NBC2907, NBC2913, NBC2981, NBC10812, NBC10838, NBC11670, NBC11770
	OB	3	YBC11129, YBC10937, NBC8126
Lagash	UrIII	12	MLC01025, MLC01049, MLC01402, NBC00033A, NBC00274, NBC05661, NBC07753, NBC11570, NBC11579, NCBT01344, NCBT01367, YBC15345
	ED	15	MLC01463, MLC01464, MLC01465, MLC01466, MLC01468, MLC01472, MLC01473, MLC01474, MLC01475, MLC01476, MLC01477, MLC01480, MLC01485, MLC01487, MLC01488

Continued

	EDIII	15	MLC02623, MLC01507, MLC01456, MLC01459, MLC01486, MLC02611, NBC10507, MLC01457, MLC01496, MLC01499, MLC02612, MLC01470, MLC01481, MLC01483, MLC01491
	UrIII-Shulgi	21	NBC00003, NBC00006, NBC00008, NBC00011, NBC00013, NBC00015, NBC00016, NBC00017, NBC00019, NBC00022, NBC00023, NBC00024, NBC00028, NBC00029, NBC00048, NBC00051, NBC00052, NBC00066, NBC00068, NBC00074, NBC00086
	UrIII-AS	17	NBC00004, NBC00077, YBC14111, YBC15960, NBC00036, NBC10010, YBC13464, NBC00088, NBC01190, NBC00041, NBC00272, NBC10876, MLC01164, NBC00060, NBC01771, NBC06716, NBC00059
	UrIII-Ibbishin	3	YBC1968, RBC305, RBC746
	OAkk	15	MLC01136, MLC01137, MLC01139, MLC01142, MLC01143, MLC01144, MLC01145, MLC01147, MLC01148, MLC01149, MLC01150, MLC01157, MLC01221, MLC01222, MLC01223
Uruk	NB	15	NBC04691, NBC04816, NBCT00153, NBCT00747, NBCT00923, YBC06854, YBC09384, YBC09389, YBC09409, YBC09416, YBC09484, YBC09569, YBC09573, YBC09626, YBC09629
	AC	16	NBC01065, NBC04642, YBC03472, YBC03707, YBC03721, YBC03777, YBC03795, YBC03809, YBC03957, YBC03982, YBC04074, YBC04097, YBC06867, YBC06908, YBC06934, YBC07425
Ur	UrIII	15	MLC01112, NBC05658, NBC05659, NBC05660, NBC05662, NBC05689, NBC05690, NBC05691, NBC05777, NBC06490, NBC08100, NBC08204, NBC08207, NBC09188, NBC09189
	OB	14	YBC04746, YBC04747, YBC05338, YBC06242, YBC05397, YBC05367, YBC05410, YBC05349, YBC05371, YBC05388, YBC05376, YBC05429, YBC04749, YBC05378
Nuzi	MB	17	YBC5125, YBC5126, YBC5127, YBC5128, YBC5129, YBC5130, YBC5131, YBC5132, YBC5133, YBC5134, YBC5135, YBC5136, YBC5137, YBC5138, YBC5139, YBC5141, YBC5143, YBC5145
Kultepe	OAss	14	NBC01655, NBC01662, NBC01671, NBC01697, NBC01703, NBC01724, NBC01760, NBC01846, NBC01890, NBC01898, NBC01906, NBC03749, NBC03754, NBC04053
Larsa	NB	15	NCBT00517, NCBT01021, NCBT00867, NCBT00534, NCBT00871, NCBT00627, YBC03527, NCBT00547, NBC01186, YBC03520, YBC03429, NCBT00623, NCBT00523, YBC06856, YBC09048
	OB	15	YBC04196, YBC04217, YBC04327, YBC04398, YBC04400, YBC04201, YBC04229, YBC04270, YBC04284, YBC04307, YBC04384, YBC04396, YBC04462, YBC04481, YBC04497
Babylon	NB	16	MLC00901, NBC01040, NBC04758, NBC04793, NBC04868, NBC06251, NCBT00647, NCBT00799, YBC03432, YBC03747, YBC04113, YBC04124, YBC09036, YBC09224, YBC09281, YBC09526
	AC	13	MLC01772, MLC01768, MLC01778, MLC01767, NBC06241, NBC04757, MLC01775, YBC11532, MLC00689, MLC00542, MLC01744, NBC06155, NBC11528
Borsippa	AC	15	NBC11550, NBC06158, YBC11289, YBC11312, NBC11525, NBC08406, RBC00738, YBC11615, NBC08410, RBC00741, NBC08405, aMLC00723, MLC00714, MLC00752, NBC08339

Continued

	NB	20	NBC08407, MLC00381, MLC00491, NBC08336, MLC00347, MLC01664, YBC07515, NBC06221, NBC08341, YBC11591, NBC08345, RBC00739, NBC08328, NBC08347, YBC07522, NBC08324, NBC08338, NBC08395, NBC08329, NBC08330
Boghazkyoy	Ht	13	NBC11779, NBC11782, NBC11786, NBC11795, NBC11798, NBC11802, NBC11827, NBC01648, NBC01879, NBC01910, NBC03940, NBC03945, NBC03991
Dilbat	ENB, NB	15	MLC00332, MLC00488, MLC00496, MLC00597, MLC01783, MLC01786, YBC11336, YBC11388, YBC11400, MLC00367, MLC00375, MLC00523, MLC01195, MLC01782, NBC08388
	OB	5	MLC00444, MLC01293, MLC01699, MLC01399, MLC01324
Kish	OB	15	YBC05952, YBC05893, YBC05875, YBC05888, YBC05938, MLC00913, YBC05878, YBC05892, YBC05858, YBC05900, YBC05981, YBC07981, YBC05861, YBC05869, YBC05899
Nimrud (Tablets)	NAss	12	ND278, ND401+ND402, ND403, ND404, ND405, ND406(a), ND409, ND411, ND412, ND416, ND423, ND425
Nimurd (Sealings/bullae)	NAss	15	ND10036, ND10038, ND10001, ND10004, ND10008, ND10009, ND10010, ND10015, ND10020, ND10024, ND10025, ND10026, ND10032, ND10035, ND10039
Nineveh (Tablets)	NAss	15	K327, K332, K333, K334, K335, K337, K338, K339, K340, K341, K343, K346, K347, K349, K350
Nineveh (Sealings/bullae)	NAss	15	K19661, K19665, K19655, K19690, K20051, K20579, K20580, K20581, K20582, K20577, K20578, K20575, K20576, K20573, K20574
Alalakh (Tablets)	OB, MB	13	131,455, 131,457, 131,458, 131,459, 131,460, 131,462, 131,454, 131,477, 131,478, 131,482, 131,484, 131,486, 131,496
Tell-Halaf (Tablets)	OAkk	10	115,010, 115,009 + 115,002, 115,008, 115,007, 115,006, 115,004, 115,003, 115,001 + 115,005 + 114,998, 115,000, 114,999
Tell-Brak (Tablets)	OAss	1	131,759
	OAkk	12	131,739, 139,751, 126,500, 131,753, 131,757, 131,756, 131,755, 131,754, 131,752, 131,751, 131,749, 131,748
	OAss + OAkk	1	131,758 + 125,922

Abbreviations: ENB, ED, Early Dynasty period (c. 2900-2340 BC); EDIII, Early Dynasty III period (c. 2600-2340 BC); OAkk, Old Akkadian period (2334-2154 BC); UrIII, Ur III period (2112-2004 BC); OB, Old Babylonian period (c. 2000-1595 BC); MB, Middle Balylonian period (c. 1595-1155 BC); ENB, Early Neo-Babylonian period (1155-626 BC); NB, Neo-Babylonian period (626-539 BC); AC, Achaemenid period (547-331 BC); AS, Assyrian period (2025-612 BC); OAss, Old Assyrian period (2025-1393 BC); NAss, Neo-Assyrian period (911-612 BC); Ht, Hittite period (c. 1680-1190 BC).

elements: Ca (1389), K (549), Fe (364), Ti (65), Rb (2), Sr (5), Mn (73), Zn (6), V (16), Cr (14), Cu (7), As (2), Y (1), Zr (2), and Pb (3). In addition to the above elements, Ni, S, Cl, and Co were also frequently detected in the clay tablets.

3. Results

3.1. Chemical Analysis

The chemical compositions of Ca, K, Fe, Ti, Rb, Sr, Mn, and Zn, which were analyzed with good precision by pXRFs for all the clay tablets from each area (listed in **Table 1**) are summarized in **Appendix**. The averaged chemical compositions of Ca, K, Fe, Ti, Rb, Sr, Mn, and Zn for each area are summarized in **Table 2**. The standard deviations (1σ) for the analysis are also shown in **Table 2**.

Table 2. Averaged chemical compositions and standard deviations (1σ) of the clay tablets determined by the portable XRFs.

Grouping*	Provenance	Ca	Std. (%)	K	Std. (%)	Fe	Std. (%)	Ti	Std. (%)	Rb	Std. (%)	Sr	Std. (%)	Mn	Std. (%)	Zn	Std. (%)
Group 1	Sippar	115,959	21.9	27,498	35.7	47,156	13.3	3971	16.8	54	21.0	496	55.4	1738	61.0	212	74.8
	Nippur	109,891	19.7	27,507	41.7	42,951	9.4	3638	11.1	54	20.6	350	39.4	1556	51.8	297	101.3
	Drehem	117,902	25.6	20,891	28.7	52,596	14.0	4396	17.3	49	19.7	479	39.1	1442	56.9	173	235.1
	Adab	107,641	18.5	27,784	38.5	47,057	15.9	3628	19.9	57	9.4	313	9.6	1363	37.0	221	77.4
	Umma	122,690	28.7	24,660	44.1	46,341	20.5	3836	25.2	52	14.6	319	22.4	1677	48.6	197	64.7
	Lagash	104,475	27.7	27,471	48.9	42,703	15.5	3597	20.0	53	23.6	381	36.2	1132	38.5	322	116.1
	Uruk	95,915	40.4	24,162	73.0	41,833	26.1	3425	31.9	56	18.6	372	52.2	1771	65.9	309	92.6
	Ur	99,175	27.6	19,773	40.5	39,699	18.7	3161	25.2	55	18.5	290	15.2	1205	46.9	204	900.4
	Larsa	108,994	34.0	16,658	36.3	40,653	21.3	3286	27.3	50	21.2	297	15.5	927	34.7	124	65.3
	Babylon	117,117	24.2	28,454	31.5	48,162	17.5	4212	20.9	52	14.2	422	26.9	1548	44.8	144	67.9
	Borsippa	126,911	21.8	24,110	35.8	48,015	14.4	4031	17.6	51	30.4	405	16.2	1174	44.4	282	118.2
	Dilbat	105,099	23.8	32,935	33.0	49,368	15.1	4235	14.8	54	20.0	409	28.0	1290	33.2	185	33.8
	Kish	104,367	42.8	11,778	55.1	38,469	36.1	3060	40.8	44	15.5	376	36.6	1031	42.7	102	15.2
Group 2	Nuzi	143,209	10.8	26,512	30.5	34,351	13.0	3129	14.3	57	10.2	311	45.2	857	37.8	96	8.5
	Nimrud (Tablets)	113,325	18.3	30,394	11.6	34,110	10.4	3352	17.5	57	20.7	572	55.6	1257	39.9	93	15.9
	Nimurd (Sealings/bullae)	139,722	31.4	23,581	9.5	32,334	14.4	3420	17.4	51	8.9	485	31.6	2278	50.2	1456	29.5
	Nineveh (Tablets)	121,345	32.8	32,995	35.8	36,431	30.8	3612	25.1	48	22.0	376	35.5	1194	46.0	80	30.3
	Nineveh (Sealings/bullae)	155,385	27.2	31,920	43.3	28,704	17.5	2788	36.8	39	25.0	415	56.5	950	48.2	178	127.4
	Tell Halaf (Tablets)	119,822	7.8	28,802	12.3	32,510	11.2	3542	30.1	55	13.1	303	20.2	754	22.6	76	10.4
	Tell Brak (Tablets)	137,666	38.5	35,522	25.1	30,893	16.8	2999	20.4	57	19.2	538	132.6	1198	122.6	1073	76.3
Group 3	Kultepe	55,681	75.5	31,711	37.9	52,620	16.1	5009	22.6	76	31.8	428	45.1	1066	38.6	98	8.3
	Boghazkyoy	26,325	31.6	35,510	27.0	52,640	13.5	6559	10.3	117	19.0	214	20.7	1359	54.0	97	3.1
Group 4	Alalakh	219,718	20.0	25,231	38.0	33,648	19.4	2723	33.4	36	47.7	696	27.1	1138	43.0	996	47.5

*Grouping on the basis of the principal component analysis and the cluster analysis.

Judging from the detection limit and precision for the pXRF calibrations, the chemical analysis data of Ca, K, Fe, Ti, Rb, Sr, Mn, and Zn were selected as candidates for multivariate analysis. However, as Mn and Zn frequently showed unusual values (**Table 2**), the multivariate analysis was conducted excluding these elements. Manganese concentration has been frequently observed on the surface of clay tablets, owing to Mn precipitation by a manganese oxidizing microbe (Laurito et al., 2005; Gütschow, 2012; Uchida & Watanabe, 2014). This may be the cause of the compositional variation in Mn on the surface of the clay tablets.

3.2. Multivariate Analysis

Principal component analysis, cluster analysis using Ward's method, and discriminant analysis were performed on the data shown in **Table 2**. Excel "Tokei" for Windows (Social Survey Research Information Co., Ltd., Tokyo, Japan) was used for the multivariate analysis.

Based on results of the principal component analysis using the averaged chemical analysis data in **Table 2** for the above-mentioned six elements (Ca, K, Fe, Ti, Rb, Sr, Mn, and Zn), the areas where the clay tablets were made were classified into four groups (**Figure 2(a)**). Group 1 corresponds to the lower stream area of the Tigris and Euphrates River, Group 2 corresponds to the upper stream area of the Tigris and Euphrates River, Group 3 corresponds to the northern and central areas (Boghazkyoy and Kultepe) in Turkey, and Group 4 corresponds to the southern area (Alalakh) in Turkey. Because Group 1 slightly overlaps with Group 2 in **Figure 2(a)**, we tried to eliminate some elements from the six elements to find the best combination of elements. As a result, we found that the combination of Ca, K, and Fe was best for the grouping. The result is shown in **Figure 2(b)**.

As it was revealed by the principal component analysis that Ca, K, and Fe are the useful components for the discrimination of the clay tablets, the Ca-K-Fe triangular diagram was drawn for all the clay tablets using the chemical analysis data in **Appendix** based on the above-mentioned four groups (**Figure 3**). The four groups are well distinguished with some overlap in **Figure 3**.

Cluster analysis using Ward's method for Ca, K, and Fe of the clay tablets in **Table 2** were carried out and the result is shown in **Figure 4** as a dendrogram. The cluster analysis was conducted for normalized values obtained by dividing the concentration for each element by the average value. At a distance of 1 in the dendrogram (**Figure 4**), the clay tablets could be classified into the same four groups obtained by the principal component analysis (**Figure 2**).

Results of the discriminant analysis using the averaged chemical analysis data for Ca, K, and Fe of the clay tablets in **Table 2** and the four groups obtained from the principal component and cluster analyses are shown in

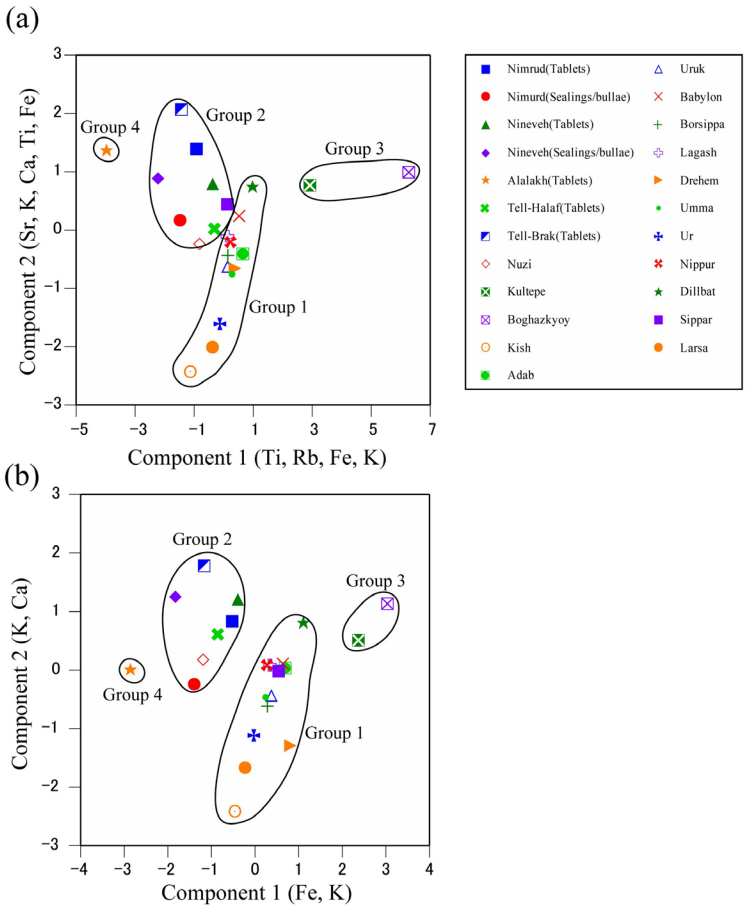

Figure 2. Results of the principal component analysis of the clay tablets. (a) Results using the averaged data for Ca, K, Fe, Ti, Rb, and Sr in **Table 2**; (b) results using the averaged data for Ca, K, and Fe, in **Table 2**. Group 1 corresponds to the lower stream area of the Tigris and Euphrates River, Group 2 corresponds to the upper stream area of the Tigris and Euphrates River, Group 3 corresponds to the northern and central areas (Boghazkyoy and Kultepe) in Turkey, and Group 4 corresponds to the southern area (Alalakh) in Turkey.

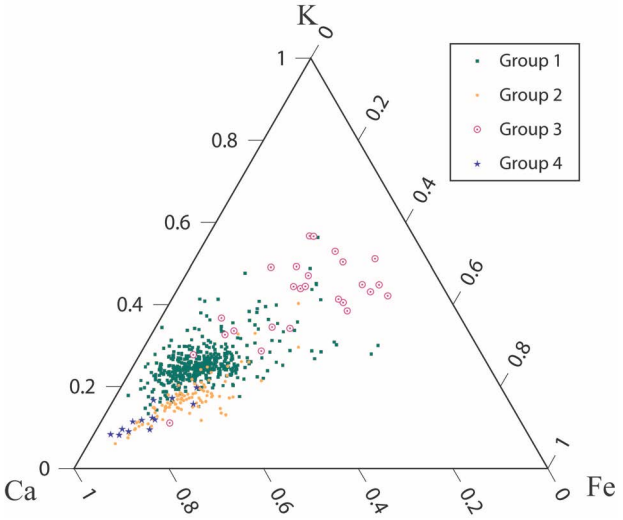

Figure 3. Ca-K-Fe triangular diagram for all the clay tablet using the data for Ca, K, and Fe in **Appendix**.

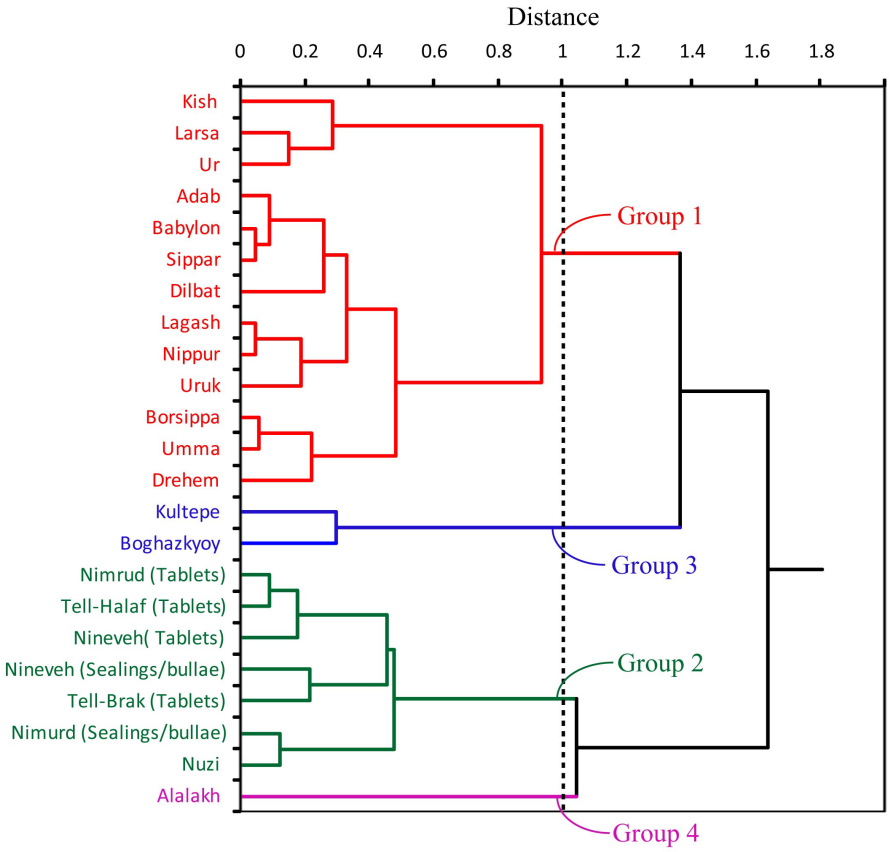

Figure 4. Result of the cluster analysis (Ward's method) using the averaged data for Ca, K, and Fe of the clay tablets in **Table 2**. The same grouping as in **Figure 2** was obtained in the cluster analysis.

Figure 5. The discriminant functions W1 and W2 describe 87.63% and 11.68%, respectively. The four groups corresponding to those obtained by the principal component analysis and the cluster analysis are well separated in **Figure 5**.

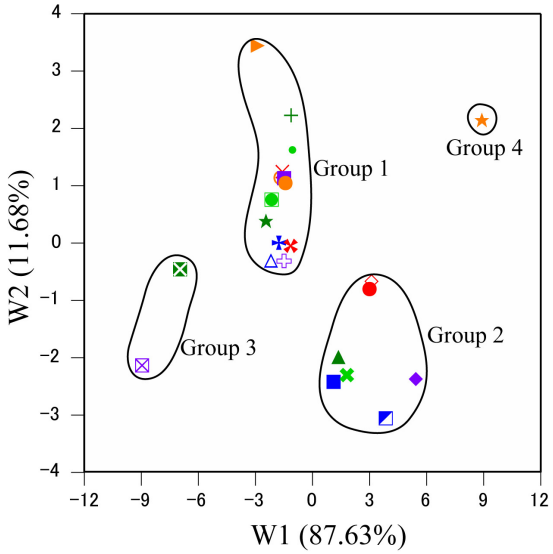

Figure 5. Results of the discriminant analysis using the averaged data for Ca, K, and Fe of the clay tablets in **Table 2** and the four groups obtained from the principal component analysis (**Figure 2**) and the cluster analysis (**Figure 4**). The four groups by the principal component analysis and the cluster analysis are well separated. The symbols are the same as those in **Figure 2**.

4. Consideration

The clay tablets were classified into four groups, as presented above, based on the multivariate analyses including the principal component analysis, cluster analysis (Ward's method), and discriminant analysis. This grouping was determined mainly by the contents of Ca, K, and Fe. In particular the Ca content was essential for the grouping. The Ca content in the clay tablets decreases remarkably in the groups in the following order (**Figure 3**): the southern area (Alalakh) in Turkey (Group 4: 22.0% in average), the upper stream area of the Tigris and Euphrates River (Group 2: 13.3%), the lower stream area of the Tigris and Euphrates River (Group 1: 11.0%), and the northern and central areas (Boghazkyoy and Kultepe) in Turkey (Group 3: 4.1%). As the raw materials of clay tablets comprised sediments from rivers or canals, their chemical content is likely controlled by the surrounding geology, especially the distribution of limestone.

Goren et al. (2010) conducted non-destructive chemical analysis using pXRF and multivariate analysis for clay tablets mainly from Ugarit (corresponding to Alalakh/Group 4 in this study), Mitanni and Assyria (corresponding to the upper stream area of the Tigris and Euphrates River/Group 2 in this study), Babylonia (corresponding to the lower stream area of the Tigris and Euphrates River/Group 1 in this study), and Hattusa (corresponding to Boghazkyoy and Kultepe/Group 3 in this study). Clay tablets from Egypt were also included in that study. On the basis of multivariate analysis, Goren et al. (2010) classified these clay tablets into five groups: Ugarit, Mitanni, Babylonia, Hattusa, and Egypt. They suggested that the above grouping might appear in a Ti-K diagram. In this context, we drew a Ti-K diagram for all the clay tablets investigated in this study (**Figure 6**), and found that the four groups were distinguished well with some overlap. Comparison of the compositional data for Ti and K in this study with those from Goren et al. (2010) shows a systematic difference. The concentration levels of K and Ti in the Goren study are significantly lower than those in this study. The difference is especially large for K; the K content found by Goren et al. (2010) is around half of that in this study. Calibration of the pXRF instruments for our study was conducted using reference rocks as mentioned above, whereas Goren et al. (2010) did not calibrate their pXRF. Calibration of pXRF using reference materials is essential (Ross et al., 2014), and thus this difference is the likely reason for the discrepancy in chemical compositions between the two studies. Discrepancies in the results were also evident for Mn and Rb. Uchida & Watanabe (2014) conducted chemical analysis of clay tablets from the lower stream area of the Tigris and Euphrates River using both an electron probe X-ray microanalyzer (EPMA) and pXRF. The results obtained by EPMA coincide with those obtained by pXRF in this study. Therefore, it is concluded that the results obtained in Goren et al. (2010) are not correct because the pXRF was not calibrated using standard materials.

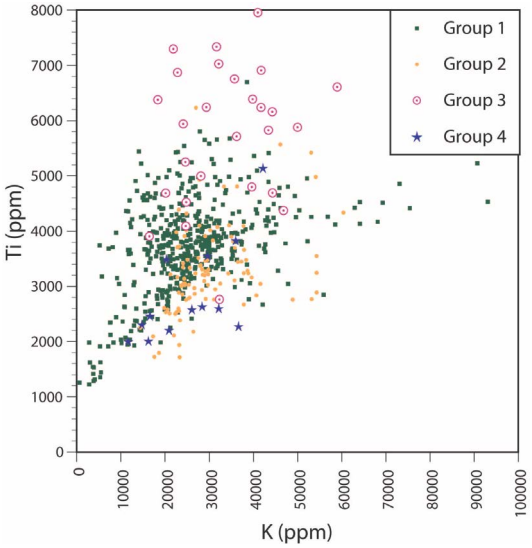

Figure 6. Ti-K diagram for all the clay tablets based on the grouping obtained by the principal component analysis (**Figure 2**) and the cluster analysis (**Figure 4**) using the data in **Appendix**. The four groups were distinguished with some overlap.

5. Summary

In summary, the principle component and cluster analyses using the average chemical compositions for K, Fe, and Ca found in clay tablets resulted in their classification into four groups, corresponding to the upper stream area of the Tigris and Euphrates River, the lower stream area of the Tigris and Euphrates River, the northern and central areas in Turkey, and the southern area in Turkey. This grouping was determined mainly by a difference in Ca content dictated by the local geology.

Acknowledgements

The non-destructive analysis of the clay tablets was conducted at the Yale Babylonian Collection of Yale University, and the British Museum. Prof. B. Foster, Dr. U. Kasten and Dr. E. Payne of Yale University, and Dr. J. Taylor of the British Museum kindly helped and supported us during the investigation. Dr. C. E. Watanabe of Osaka Gakuin University kindly arranged the investigation at Yale University and the British Museum. We express our heartfelt gratitude to all of them. This research was supported in part by a Grant-in-Aid for Scientific Research of the Japan Society for the Promotion of Science (Grant No. 23310190: C. E. Watanabe).

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Appendix

Chemical compositions of all the clay tablets determined by the portable XRFs

Area	Sample number	Ca (μg/g)	K (μg/g)	Fe (μg/g)	Ti (μg/g)	Rb (μg/g)	Sr (μg/g)	Mn (μg/g)	Zn (μg/g)
Sippar	YBC04319	102,428	26,778	43,963	3318	52	370	857	122
	YBC04328	102,062	25,579	40,524	3240	52	364	765	86
	YBC04329	135,553	31,237	46,343	3651	58	420	2860	486
	YBC04346	112,351	20,478	37,728	2760	53	363	932	96
	YBC04580	112,976	31,638	44,136	3459	52	356	1126	689
	YBC06816	133,664	27,707	51,863	4600	66	426	1039	344
	YBC06972a	54,920	73,079	57,122	4855	55	427	1175	202
	YBC06972b	125,427	33,299	50,109	3957	48	568	1407	134
	YBC06981	90,939	30,068	37,808	3295	52	329	1011	78
	YBC04962	134,496	21,969	49,513	3870	60	398	1025	351
	YBC04975	117,475	29,045	45,005	3819	62	396	1910	212
	YBC04976	103,460	35,096	46,384	3962	53	357	1251	350
	YBC04980	106,877	28,387	46,485	4051	59	399	1617	344
	YBC04983	102,706	24,864	43,143	3386	56	368	1150	235
	YBC05477	118,690	30,158	47,303	3525	66	406	1414	372
	YBC05558	56,933	12,078	30,226	2034	47	345	1185	65
	YBC06808	125,011	28,309	50,446	3980	56	389	1170	382
	NBC06134	113,754	23,316	49,944	4495	52	340	1104	118
	NBC06173	98,122	27,478	49,292	4310	57	357	2291	96
	NBC06136	109,802	27,193	48,471	3817	59	365	1118	98
	NBC06169	107,240	25,711	52,499	4904	54	328	1966	113
	NBC06165	107,103	29,538	52,551	4837	49	394	2462	114
	MLC01667	147,339	20,576	38,915	2701	53	436	1609	95
	NBC06231	131,474	27,098	44,060	4243	55	401	2632	95
	NBC06240	123,637	26,939	51,249	4644	54	386	2442	128
	MLC01779	108,777	42,719	46,973	3616	41	550	1127	94
	NBC06184	137,726	24,701	56,711	4616	57	459	2789	101
	NBC06208	123,477	43,425	65,985	5412	108	444	4158	119
	NBC06153	131,511	23,868	42,975	3528	49	455	2582	95
	NBC06244	196,245	11,219	49,982	4360	24	975	1091	109
	NBC06237	176,151	20,827	50,890	3948	47	787	2226	124
	NBC06189	117,041	31,526	47,154	3851	49	414	2985	97
	YBC03542	130,439	22,305	50,339	4179	57	1510	5369	394

Continued

	YBC03542	128,972	24,138	49,838	4041	57	1512	4202	372
	NBC06154	108,522	36,770	51,435	4348	60	402	1094	619
	NBC06120	94,268	31,321	42,805	3654	51	349	1087	190
	NBC06113	99,656	29,333	43,591	4171	47	363	1196	148
	NBC06128	106,005	23,801	40,492	3405	55	355	862	95
Nippur	NBC06646	78,702	25,065	45,171	3557	54	310	3386	194
	NBC06696	66,186	40,579	48,524	4391	64	406	3538	179
	NBC07628	124,392	24,987	44,648	3431	51	519	2540	188
	NBC08507	114,813	47,866	41,286	3044	49	353	1177	146
	NBC09928 (unbaked)	111,510	52,250	45,695	3816	57	545	1788	228
	NBC09928 (baked)	127,252	26,944	43,457	3624	30	383	929	250
	NBC10061	106,871	58,530	47,713	4117	58	934	1240	288
	NBC10384	123,133	35,320	56,863	4313	45	584	2911	771
	NBC10537	116,171	27,140	42,565	3441	54	282	880	76
	NBC10540	951,09	22,712	39,584	3065	56	309	4079	79
	NBC10583	98,956	24,810	40,402	3274	58	331	1571	117
	NBC10784	113,029	27,533	45,978	3891	67	361	3228	109
	NBC11305	114,010	23,199	39,039	2907	57	299	1605	116
	NBC04717	113,711	19,267	38,091	3243	48	381	960	723
	NBC04755	104,788	22,867	46,542	4040	51	306	1002	265
	NBC06119	68,868	30,488	42,672	3353	71	257	2992	178
	NBC06138	83,713	31,124	43,495	3976	56	301	1331	301
	NBC06179	86,017	32,031	42,444	3914	56	675	1242	352
	NBC06186	127,414	11,959	40,988	3659	35	320	1022	1652
	NBC06200	92,961	56,855	46,911	4261	62	333	2648	203
	NBC06226	115,866	20,561	47,350	4018	22	371	1583	260
	NBC08377	129,846	14,390	48,151	3944	33	398	1362	1231
	NBC08398A	124,272	16,509	43,432	3966	30	319	1009	424
	YBC09142	107,572	38,193	50,540	4028	55	337	2532	395
	YBC09232	116,789	21,213	42,732	3524	52	274	1307	1054
	YBC09245	102,065	21,100	41,395	3798	48	317	1661	624
	YBC09441	101,160	32,206	42,944	4141	56	325	802	157
	YBC09525	118,770	27,658	47,178	4144	52	339	2574	177
	MLC01663	102,229	37,317	35,335	3113	54	343	908	78
	NBC04664	111,574	24,086	38,811	3538	56	344	1033	725
	NBC04761	120,648	21,740	43,026	3593	51	317	2300	191

Continued

NBC04777	128,692	20,593	43,695	3921	43	367	1635	232
NBC04781	108,421	25,263	42,948	3618	46	314	979	303
NBC04782	116,013	19,262	42,512	3593	46	314	1087	188
NBC06133	84,766	35,233	40,378	3683	60	295	2217	266
NBC06229	115,707	25,256	43,807	3717	46	319	2025	195
RBC00273	141,786	16,051	41,214	3567	40	416	906	775
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NBC06904	125,006	24,160	33,317	2777	41	774	778	230
NBC06913	106,258	23,599	44,769	3806	42	450	1401	737
NBC06915	95,098	25,090	39,627	3338	55	326	1425	118
NBC06919	129,494	35,783	46,641	3807	73	1017	1465	1377
NBC06933	109,130	13,547	36,514	2370	47	529	1645	286
NBC06984	90,237	23,988	40,690	3149	54	378	2470	151
NBC07066	100,749	28,434	40,818	3665	54	301	1566	144
NBC06977	86,461	28,038	39,185	3390	52	343	916	130
NBC10212	115,525	20,777	45,154	3772	45	315	1096	248
NBC11106	133,760	28,164	44,194	3733	48	414	1330	765
NBC11263	69,537	27,414	45,050	3591	69	244	1051	126
NBC11264	69,468	25,045	40,156	3318	56	244	1578	127
NBC11269	86,674	32,803	43,640	3473	68	274	1923	118
NBC11282	88,224	25,803	38,904	3139	61	293	2970	131
NBC11207	33,314	33,819	52,039	4745	73	191	1668	146
NBC05577	150,170	23,438	35,500	3004	60	252	684	221
NBC11285	112,179	21,196	46,586	3518	52	306	2993	136
YBC15991	81,221	30,181	41,248	3863	63	249	1341	330
YBC11974	109,667	30,186	43,135	3619	54	276	2295	127
NBC06510	114,147	23,533	45,037	3551	60	262	1618	183
NBC06760	100,338	24,200	37,126	3255	54	257	805	181
NBC08935	87,531	35,101	40,736	3493	61	262	2537	214
NBC07993	107,634	44,741	46,244	3974	67	385	869	604
NBC08000	103,433	26,866	47,556	4102	76	259	926	556
NBC08037	126,608	25,042	42,040	3676	55	326	903	345
NBC07938	44,513	93,080	53,276	4531	96	285	2354	158
NBC07941	108,913	37,594	47,057	3991	56	286	861	489
NBC07950	126,820	32,740	43,252	3873	54	308	1673	501
NBC07957A	124,558	26,946	44,761	3783	54	314	847	414

Continued

	NBC07961	124,571	25,660	42,933	3712	46	447	903	198
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	NBC07966	133,306	21,269	42,120	3790	47	355	785	341
	NBC07949	128,028	30,003	41,895	3607	49	480	999	200
	NBC07962	113,308	27,371	46,432	4010	68	290	1132	265
	NBC07976	144,859	17,986	41,519	3545	48	464	816	146
	NBC07991	120,617	19,598	43,221	3607	46	252	918	588
	NBC07935	136,940	19,572	45,893	3715	56	296	1569	624
	NBC07956B	139,179	19,421	42,224	3702	45	337	893	376
	NBC07958	132,286	25,689	46,626	4040	61	333	3201	370
	NBC08038	119,965	29,348	45,816	3857	66	261	1632	106
	NBC02204	103,150	24,367	44,236	4178	56	403	2354	87
	NBC03611	57,629	26,379	53,664	4788	48	436	1574	197
	NBC04219	24,311	27,870	67,214	5807	46	341	1821	108
	NBC04236	71,089	19,687	45,628	3444	53	358	895	104
	NBC05074	112,649	16,314	39,300	2895	53	352	1091	83
	NBC05083	130,177	15,642	45,232	3297	46	337	2389	96
	NBC05597	120,366	23,312	60,455	5005	42	506	1246	271
	NBC05607	116,926	18,758	55,585	4431	46	755	1112	127
	NBC06563	115,523	17,918	56,949	4683	27	381	1119	270
	NBC06683	113,004	19,267	45,163	3506	47	415	1175	279
	NBC06690	102,316	34,816	49,930	4153	52	889	1149	277
	NBC06692	153,704	19,611	47,580	3909	52	608	871	2290
Drehem	YBC15751	128,149	21008	43,354	3542	52	452	1636	688
	YBC15763	122,644	11,782	50,194	3581	23	429	974	265
	YBC15904	109,828	31,224	51,877	4568	57	688	1330	312
	NBC00142	141,432	22,419	62,047	5428	51	447	2036	122
	NBC00144	136,972	19,379	54,937	4668	55	393	2129	132
	NBC02494	113,140	16,111	42,939	3588	45	310	829	95
	NCBT01395	122,489	26,298	54,238	4959	44	1061	1910	95
	NCBT01422	66,376	30,567	66,773	5302	54	726	4941	95
	NCBT02347	125,926	32,170	48,630	3815	54	531	1266	96
	RBC00420	127,349	13,345	56,084	4908	26	360	1125	126
	YBC01582	83,880	16,641	57,127	4620	49	352	1096	95
	YBC01589	119,797	25,339	57,724	4717	56	431	1176	145

Continued

	YBC01590	133,702	22,926	59,022	5433	50	395	1346	106
	YBC09825	168,777	16,470	44,284	3424	36	828	2835	97
	YBC13472	127,748	20,367	46,750	4196	38	596	796	95
	YBC13674	141,329	15,146	57,317	4560	49	403	1629	111
	YBC14224	141,841	16075	58,881	5010	28	389	1072	109
	YBC16845	146,411	14,064	60,596	5438	56	466	1555	134
Adab	NBC06632	65,767	10,906	39,322	2619	52	320	2841	112
	NBC06673	95,951	15,546	34,566	2419	51	332	724	76
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	NBC06733	74,748	19,877	50,202	3314	61	249	1006	98
	NBC06744	120,294	43,167	54,735	4248	56	289	1528	86
	NBC08184	124,593	38,937	60,748	4980	65	351	1902	247
	NBC08192	113,169	44,557	54,033	4243	62	308	1623	373
	NBC08213	125,133	31,092	50,635	3910	66	363	1554	282
	NBC08217	121,039	19,906	48,316	3947	51	273	1016	465
	NBC08219	113,949	41,382	53,904	4528	61	309	1458	267
	NBC09950	129,222	22,785	44,859	3508	62	314	1666	622
	NBC09953	90,760	24,430	43,176	3590	54	310	1255	441
	NBC10111	117,269	29,025	46,682	3725	56	319	1380	200
	NBC10112	117,352	28,801	48,874	3718	60	332	1215	158
	NBC10161	82,505	15,371	34,599	2692	49	331	877	70
Umma	YBC15320	103,103	24,045	37,208	2873	60	251	857	80
	YBC15328	79,111	26,775	42,060	3502	57	242	1867	87
	YBC15243	99,880	29,985	45,777	3731	57	259	1730	63
	NBC03181	100,496	32,629	43,068	3502	60	241	2992	91
	YBC14149	143,147	23,720	41,144	3320	54	271	834	87
	YBC14165	144,445	20,669	37,990	2587	57	281	784	78
	YBC14515	107667	29,358	45,867	3011	54	240	1029	100
	YBC14076	69,945	13,491	39,665	2594	62	259	1896	93
	YBC14854	121,739	16,505	36,492	2548	47	284	763	76
	YBC14436	98,947	32,443	51,410	4908	52	292	1018	92
	YBC14193	111,073	24,402	44,368	3586	52	284	1172	61
	YBC04757	107,615	29,178	44,902	3765	62	256	1182	84
	NBC03591	143,122	45,597	46,221	3280	55	387	1481	79
	MLC02307	108,704	64,110	48,758	4134	59	643	1066	96
	YBC04191	137,569	40,831	64,524	5092	74	309	1080	209

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	NBC05803	52,156	7591	31,004	2346	52	258	2445	69
	NBC05847	142,699	23,944	54,482	4858	40	325	2557	194
	NBC05849	104,336	21,836	41,955	3309	53	255	1163	61
	NBC05850	102,504	10,393	31,025	2361	56	264	3833	85
	NBC05851	103,729	26,211	39,569	3469	54	330	2319	183
	NBC05852	137,949	18,261	45,611	3837	53	346	1219	189
	NBC05853	204,385	31,739	69,344	5654	57	322	3794	189
	NBC05854	197,529	31,337	58,575	4981	48	311	1612	145
	NBC05855	166,186	26,912	59,775	4811	52	293	1540	133
	NBC05857	202,874	29,007	65,440	5651	57	335	1380	219
	NBC05858	148,127	15,684	48,950	4567	39	319	1628	137
	NBC05860	81,880	12,903	34,437	3022	50	268	1994	73
	NBC05861	141,041	14,578	48,795	4250	40	286	1400	607
	NBC05916	111,122	25,313	46,199	3392	47	285	1183	61
	NBC06921	104,918	34,622	58,718	5674	58	300	1694	184
	YBC11129	117,041	19,424	40,864	3448	48	342	1876	221
	YBC10937	110,726	23,961	42,782	3796	51	359	3109	469
	NBC8126	117,640	18,147	46,925	3969	36	346	1153	452
Lagash	MLC01025	83,420	20,681	34,159	2632	51	298	657	68
	MLC01049	74,576	29,153	40,897	3549	56	369	860	305
	MLC01402	49,913	68,136	51,074	4169	81	329	933	118
	NBC00033A	115,079	42,670	46,120	3760	52	840	1332	476
	NBC00274	107,041	25,895	47,375	3738	42	319	1034	385
	NBC05661	46,513	28,296	49,674	3763	59	223	739	116
	NBC07753	102,937	24,568	46,625	3552	55	358	1048	138
	NBC11570	110,758	25,673	46,734	3949	61	347	838	382
	NBC11579	119,547	22,663	45,740	3866	61	303	893	531
	NCBT01344	120,181	55,869	37,462	2847	53	836	968	147
	NCBT01367	115,358	15,320	47,081	3673	59	328	815	126
	YBC15345	101,899	36,272	43,825	3484	55	382	989	212
	MLC01463	94,444	20,884	33,391	2819	45	590	761	92
	MLC01464	114,557	20,708	35,345	2727	52	289	847	81
	MLC01465	100,031	32,788	39,525	3416	49	335	2224	95
	MLC01466	101,472	35,293	44,776	3591	57	312	1117	240
	MLC01468	88,259	42,445	44,812	3687	52	475	1665	390
	MLC01472	122,345	35,798	42,119	2986	57	370	1406	108

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MLC01473	88,044	20,622	34,792	2921	55	264	797	86
MLC01474	100,729	33,145	38,367	3315	55	447	928	91
MLC01475	102,024	29,921	41,926	3624	53	279	1108	88
MLC01476	94,227	37,315	44,292	3756	53	338	1073	271
MLC01477	89,317	20,385	37,097	2636	55	287	996	100
MLC01480	41,279	21,433	40,952	3362	56	240	914	88
MLC01485	78,608	38,644	51,770	4698	51	590	1171	78
MLC01487	106,853	29,249	39,625	3311	55	288	853	111
MLC01488	99,496	35,918	42,965	3968	57	429	1113	208
NBC00004	106,701	28,449	50,056	3865	55	377	1448	337
NBC00077	96,705	44,601	52,345	4489	76	465	1265	516
YBC14111	84,506	22,824	55,303	5037	33	415	1076	73
YBC15960	136,813	26,630	36,456	3151	64	294	821	484
NBC00036	120,915	15,639	44,522	3871	46	370	927	343
NBC10010	130,878	5190	46,646	3740	13	450	928	132
NBC10010	125,574	8123	46,331	3709	10	394	946	163
YBC13464	114,102	19,273	42,618	3740	42	380	1136	146
NBC00088	65,053	45,720	55,470	4646	68	417	2813	1757
NBC01190	120,870	22,869	45,176	4054	47	283	1752	211
NBC00041	63,502	64,085	51,349	4524	71	662	1245	805
NBC00272	38,219	15,492	33,392	2541	55	244	529	83
NBC10876	108,573	35,337	44,373	3556	66	284	952	135
MLC01164	91,181	35,799	41,226	3646	51	373	1357	121
NBC00060	126,162	15,997	47,430	4203	37	367	1413	284
NBC01771	72,276	75,418	54,044	4415	99	544	1637	212
NBC06716	103,300	26,012	40,740	3483	56	282	1651	225
NBC00059	98,379	46,178	51,194	4418	53	611	1767	443
MLC02623	133,984	12,278	31,074	2186	51	332	504	83
MLC01507	164,254	18,970	28,348	1981	48	346	744	59
MLC01456	32,278	37,120	48,596	4936	49	358	1342	315
MLC01459	110,904	25,330	39,247	3058	55	291	1757	95
MLC01486	104,847	28,280	39,335	3398	47	466	1224	153
MLC02611	17,345	29,963	47,278	5579	61	249	975	337
NBC10507	150,401	19,902	35,117	2579	54	468	1220	97
MLC01457	95,648	41,247	38,967	3732	57	573	1827	103
MLC01496	90,584	29,910	40,053	3575	52	271	1256	84

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MLC01499	27,575	29,901	47,244	4093	55	300	1193	100
MLC02612	32,026	34,846	54,469	5289	54	321	1161	125
MLC01470	75,081	25,650	39,165	3550	47	298	995	80
MLC01481	148,570	42,086	34,041	2671	51	519	783	67
MLC01483	80,495	26,178	43,885	3696	53	290	1065	95
MLC01491	104,889	21,138	40,882	3000	54	433	915	86
MLC01136	80,714	24,146	40,400	3498	58	291	771	88
MLC01137	130,880	14,237	26,765	2213	47	252	653	66
MLC01139	119,360	17,090	29,688	2447	56	242	920	62
MLC01142	100,561	20,435	35,722	2887	60	305	843	83
MLC01143	124,428	16,979	32,710	2560	50	302	671	79
MLC01144	102,997	23,601	36,567	3139	56	245	712	78
MLC01145	99,918	22,409	36,624	3161	51	267	823	78
MLC01147	104,648	19,311	34,168	2847	58	237	717	72
MLC01148	114,706	19,528	35,631	2925	57	244	1007	67
MLC01149	68,580	20,590	37,740	3231	62	203	692	83
MLC01150	107,775	19,384	36,576	2790	56	279	629	80
MLC01157	116,008	18,201	33,609	2778	53	238	667	70
MLC01221	132,237	13,027	25,067	1933	47	232	708	59
MLC01222	122,941	18,305	30,190	2403	56	239	585	69
MLC01223	102,470	22,650	38,131	3051	56	253	905	85
YBC1968	106,603	32,606	46,100	3889	63	278	902	185
RBC305	127,591	18,833	45,979	3691	33	615	1174	331
RBC746	139,344	8904	45,340	3968	32	334	2014	1683
NBC00003	181,452	5693	40,619	3175	27	603	1565	588
NBC00006	109,004	22,581	46,031	4300	47	326	1172	1115
NBC00008	116,585	23,003	45,357	4204	38	340	1011	516
NBC00011	134,403	20,973	43,870	3945	44	571	1126	334
NBC00013	111,456	37,398	44,306	3800	68	720	1098	313
NBC00015	126,598	23,951	48,390	4460	42	538	2275	559
NBC00016	137,667	20,020	44,193	3963	44	598	1975	483
NBC00017	88,586	49,412	50,960	4634	66	522	1304	480
NBC00019	82,626	50,412	52,749	4376	73	454	1286	500
NBC00022	98,730	37,832	43,695	4173	59	424	1274	558
NBC00023	88,444	43,343	46,436	4390	64	393	1279	1030
NBC00024	117,838	20,205	44,787	3744	38	361	981	160

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	NBC00028	104,679	31,603	50,236	4188	75	486	1205	623
	NBC00029	140,610	24,549	42,122	3727	39	667	1174	446
	NBC00048	61,469	69,265	52,083	4513	78	538	1870	1347
	NBC00051	106,249	43,456	46,964	4181	64	546	1067	991
	NBC00052	101,520	39,554	44,580	4056	61	321	2502	1053
	NBC00066	95,223	20,654	39,340	3403	53	310	1840	306
	NBC00068	128,523	29,831	44,161	3686	67	616	1490	351
	NBC00074	115,320	45,175	47,238	4116	64	512	1432	1804
	NBC00086	68,198	53,113	48,989	4257	76	346	1782	1215
Uruk	NBC04691	116,692	19,662	49,717	3899	40	274	3466	247
	NBC04816	55,337	3822	15,566	1288	44	236	587	59
	NBCT00153	41004	13,250	29,942	2375	55	241	1154	72
	NBCT00747	132,636	24,152	37,449	3222	58	352	1273	163
	NBCT00923	106,695	27,635	52,156	4352	53	442	1390	186
	YBC06854	111,725	23,332	50,780	4247	40	287	2073	384
	YBC09384	25,444	2829	19,920	1223	49	314	628	65
	YBC09389	34,602	4120	19,680	1316	53	332	1569	57
	YBC09409	38,513	7660	32,465	2347	60	327	4289	90
	YBC09416	54,281	30,422	48,389	4222	59	298	2293	96
	YBC09484	46,795	7159	24,705	1910	51	357	1332	71
	YBC09569	107,080	26,841	50,566	4278	57	297	3469	141
	YBC09573	118,680	27,794	49,460	4189	62	304	4488	212
	YBC09626	66,456	30,984	52,542	5217	55	368	1680	108
	YBC09629	31,182	5487	21,730	1441	45	293	748	65
	NBC01065	168,587	22,897	37,071	2524	69	660	864	638
	NBC04642	127,823	18,651	45,948	3726	33.3	295	1849	708
	YBC03472	145,057	12,809	43,707	3387	51	339	1473	1057
	YBC03707	111,536	32,890	46,275	3737	72.7	313	2087	414
	YBC03721	124,470	16,403	45,599	3642	56.3	309	2335	602
	YBC03777	111,746	37,126	45,289	3811	61.6	590	940	267
	YBC03795	128,708	15,662	44,444	3663	41.6	352	1707	510
	YBC03809	95,979	32,900	48,053	4034	57.8	343	1023	214
	YBC03957	86,766	62,949	50,427	4425	62	1136	1065	560
	YBC03957	38,474	90,728	55,509	5230	75	840	2847	198
	YBC03982	105,702	43,979	47,657	3972	61.9	721	1153	1167
	YBC04074	134,316	18,250	44,448	3624	44.8	411	900	367

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	YBC04097	109,137	31,818	45,874	3805	74.4	306	1303	435
	YBC06867	118,975	27,684	48,535	4355	51.6	407	1936	177
	YBC06908	124,946	24,941	44,745	3822	56.6	292	1551	296
	YBC06934	106,055	36,337	47,440	3949	62.4	309	1687	622
	YBC07425	108,729	32,016	44,682	3712	70.9	289	5277	561
Ur	MLC01112	93,638	22,343	39,991	3371	44	323	919	326
	NBC05658	95,869	24,493	38,609	2979	53	304	1294	77
	NBC05659	103,805	30,686	42,603	3660	56	303	992	77
	NBC05660	91,565	18,164	35,184	2834	47	336	742	83
	NBC05662	86,858	22,218	38,946	2953	56	274	1269	103
	NBC05689	97,300	24,386	38,777	3091	54	307	1298	76
	NBC05690	68,285	10,050	33,167	2033	53	297	912	96
	NBC05691	86,221	21,232	39,436	2946	59	268	836	83
	NBC05777	57,285	3656	25,306	1541	48	245	634	62
	NBC06490	38,217	5273	29,979	1912	58	219	509	76
	NBC08100	125,399	24,829	48,493	3440	72	287	1568	373
	NBC08204	90,146	7660	31,693	2118	64	240	1106	78
	NBC08207	74,871	15,160	36,120	2352	57	250	681	78
	NBC09188	129,534	24,101	51,383	4191	59	291	1906	219
	NBC09189	148,218	21,494	53,304	4288	51	276	1662	2904
	YBC04746	116,381	16,685	43,219	3502	55	257	1059	109
	YBC04747	51,800	21,887	41,718	3491	60	233	1331	87
	YBC05338	124,062	27,029	41,970	3582	55	356	1522	190
	YBC06242	102,436	29,972	45,209	3783	58	320	1578	9720
	YBC05397	101,525	23,931	38,622	3236	62	250	1131	310
	YBC05367	129,455	23,553	42,775	3702	53	340	3225	1173
	YBC05410	110,847	29,396	44,381	3853	59	320	1842	193
	YBC05349	120,568	17,264	37,407	3227	47	268	1724	178
	YBC05371	118,112	21,341	34,571	3148	56	304	1629	226
	YBC05388	116,164	20,761	44,370	3729	39	322	999	265
	YBC05376	65,835	5318	21,130	1354	56	232	465	66
	YBC05429	105,084	31,142	49,343	4138	86	353	1662	274
	YBC04749	61,323	8319	29,549	1977	56	249	531	76
	YBC05378	138,872	11,578	43,411	3657	27	404	1076	198

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Nuzi	YBC5125	126,511	25,550	33,447	2794	61	311	640	94
	YBC5126	138,316	25,059	32,078	3478	50	299	654	92
	YBC5127	122,950	28,929	39,547	3195	67	308	835	96
	YBC5128	133,756	26,874	35,712	3231	61	286	704	93
	YBC5129	161,892	19,793	31,739	2608	52	319	1112	96
	YBC5130	156,541	23,087	32,799	2886	56	306	659	96
	YBC5131	131,721	54,303	38,702	3546	67	407	1357	95
	YBC5132	135,980	27,938	34,061	3367	53	343	825	95
	YBC5133	136,086	24,474	35,637	3050	59	294	1022	94
	YBC5134	133,358	25,574	36,039	3333	61	283	635	95
	YBC5135	139,280	29,596	36,361	3476	55	293	789	94
	YBC5136	155,919	25,392	31,091	3026	53	331	578	95
	YBC5137	174,120	17,275	24,681	2092	48	323	787	94
	YBC5138	171,199	29,817	35,359	3300	52	346	1809	116
	YBC5139	155,347	20,136	29,912	2529	53	297	1076	94
	YBC5141	152,644	24,465	31,757	3021	53	303	568	93
	YBC5143	133,287	29,753	36,128	3218	65	279	1082	94
	YBC5145	129,513	37,754	45,939	4092	61	897	1184	122
Kultepe	NBC01655	26,155	24,094	61,469	5940	57	355	914	103
	NBC01662	31,356	24,593	54,267	5250	61	594	884	106
	NBC01671	163,968	32,302	24,541	2762	82	941	2402	94
	NBC01697	58,089	44,313	53,213	4691	135	374	907	96
	NBC01703	36,678	28,108	51,708	4997	70	650	1004	98
	NBC01724	16,593	58,954	55,004	6608	113	216	978	94
	NBC01760	66,162	39,632	55,716	4798	65	510	1100	97
	NBC01846	108,722	20,132	49,529	4687	71	415	1018	98
	NBC01890	85,741	46,807	53,282	4371	93	315	1279	104
	NBC01898	11,987	41,750	56,236	6910	96	251	1393	99
	NBC01906	65,119	16,431	47,312	3906	53	420	914	98
	NBC03749	82,684	24,776	52,106	4523	58	460	999	95
	NBC03754	72,018	24,688	48,873	4091	59	546	748	93
	NBC04053	18,858	29,338	54,192	6241	91	250	1406	125
Larsa	NCBT00517	137,704	19,689	46,674	3863	52	326	1107	100
	NCBT01021	133,863	12,263	45,672	3594	44	313	1132	101
	NCBT00867	109,718	22,833	42,359	3299	54	337	986	98

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	NCBT00534	109,894	23,842	43,245	3388	57	333	978	109
	NCBT00871	161,442	21,238	41,952	3456	59	298	885	115
	NCBT00627	112,409	25,124	44,626	3689	60	339	1548	108
	YBC03527	135,660	17,501	50,702	4213	46	273	1158	127
	NCBT00547	119,933	21,708	44,152	3676	52	304	1021	104
	NBC01186	145,767	11,995	52,595	4554	34	345	1101	111
	YBC03520	139,376	11,667	51,217	4353	41	268	1501	130
	YBC03429	161,643	7255	46,175	3684	25	394	1229	144
	NCBT00623	169,833	16,413	42,818	4114	50	279	848	101
	NCBT00523	126,020	19,152	47,759	4402	46	335	1218	103
	YBC06856	120,734	17,266	50,360	3987	45	331	1078	97
	YBC09048	148,384	15,172	49,571	4268	26	315	1259	154
	YBC04196	37,246	5327	26,063	1622	51	272	491	68
	YBC04217	107,737	23,060	37,208	2940	46	394	688	329
	YBC04327	119,834	16,660	44,851	3785	26	360	1375	240
	YBC04398	105,595	25,780	48,520	3846	69	247	1524	329
	YBC04400	111,716	16,960	44,746	3719	50	324	1267	343
	YBC04201	57,177	13,005	31,852	2287	54	267	740	75
	YBC04229	65,082	15,618	35,935	2821	60	231	706	73
	YBC04270	73,416	11,537	26,875	1946	58	275	569	64
	YBC04284	47,651	3772	21,931	1412	47	250	430	53
	YBC04307	55,444	14,591	30,553	2202	62	218	572	80
	YBC04384	70,445	20,292	32,951	2901	50	229	650	76
	YBC04396	115,567	27,825	47,492	3816	61	316	898	218
	YBC04462	66,000	11,024	29,160	2067	53	254	643	71
	YBC04481	59,555	10,144	29,191	1969	53	266	582	68
	YBC04497	85,700	18,364	34,759	2678	53	325	686	74
Babylon	MLC00901	129,790	34,952	40,725	3255	52	645	1318	95
	NBC01040	116,034	23,161	55,143	4684	45	382	2000	136
	NBC04758	121,697	23,457	56,509	5251	54	372	1090	114
	NBC04793	126,473	17,605	53,094	4600	48	376	1249	118
	NBC04868	134,909	14,612	56,643	5223	44	377	1281	132
	NBC06251	105,377	27,592	56,029	4677	62	552	1914	98
	NCBT00647	139213	17,688	47,325	4263	48	393	1276	103
	NCBT00799	39,045	38,512	73,839	6700	68	284	2355	108
	YBC03432	124,899	31,829	55,573	4836	58	371	1192	115

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	YBC03747	103,125	30,590	46,078	3893	54	279	1621	96
	YBC04113	132,133	21,449	53,113	4434	49	316	1799	95
	YBC04124	35,549	10,864	42,237	2842	51	387	1336	95
	YBC09036	118,040	23,068	57,631	4696	55	356	1639	97
	YBC09224	143,817	19,570	51,591	4410	49	383	1056	111
	YBC09281	107,483	26,062	55,969	5242	48	375	1244	103
	YBC09526	118,573	27,538	55,414	4975	47	402	1662	120
	MLC01772	70,517	47,248	41,258	3776	48	557	1307	98
	MLC01768	148,698	26,020	33,812	2415	51	400	1842	112
	MLC01778	94,583	33,818	41,398	3896	50	327	2492	119
	MLC01767	123,293	31,949	37,082	3398	51	379	1457	128
	NBC06241	112,838	28,505	48,483	4023	69	397	998	486
	NBC04757	130,354	28,403	48,247	3856	50	448	1057	381
	MLC01775	88,957	32,291	47,034	4188	63	748	4292	151
	YBC11532	137,691	12,300	48,236	4070	45	603	1078	334
	MLC00689	112,279	31,867	40,196	3356	45	430	1736	93
	MLC00542	62,854	42,675	47,634	4194	52	385	1427	161
	MLC01744	122,672	39,221	41,474	3055	42	584	780	108
	NBC06155	122,548	24,954	36,445	3161	48	559	2773	90
	NBC11528	108,189	39,782	48,542	4110	68	352	1677	299
Borsippa	NBC11550	159,857	16,170	47,554	3790	46	422	905	120
	NBC06158	50,880	3876	24,921	1529	49	320	563	93
	YBC11289	180,919	19,545	41,252	3382	48	629	898	153
	YBC11312	149,621	31,544	42,109	3327	58	513	820	139
	NBC11525	141,413	25,941	52,912	4486	55	395	966	119
	NBC08406	105,488	27,184	44,998	3619	55	371	822	94
	RBC00738	159,643	13,631	54,960	4727	26	467	2027	193
	YBC11615	123,310	20,950	58,827	5099	77	455	3492	119
	NBC08410	80,845	40,144	62,369	5359	67	338	1330	115
	RBC00741	155,164	14,910	51,314	4605	30	434	1773	169
	NBC08405	149,754	20,315	54,160	4978	52	368	1375	124
	MLC00723	67,624	43,422	60,834	4889	64	473	1552	98
	MLC00714	120,101	35,111	43,754	3649	54	444	1677	95
	MLC00752	106,102	29,632	43,757	3469	58	321	1088	95
	NBC08339	102,301	26,879	45,103	3350	60	323	978	94
	NBC08407	138,347	17,841	46,407	3975	38	428	958	244

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	MLC00381	131,312	29,545	50,544	4259	58	389	1009	1363
	MLC00491	69,614	18,966	36,236	2920	51	324	1187	84
	NBC08336	126,600	22,268	48,008	3995	37	448	968	881
	MLC00347	137,517	29,882	47,551	3849	78	304	1251	150
	MLC01664	134,550	15,696	45,887	3880	34	434	939	1090
	YBC07515	89,392	29,669	45,169	3618	34	428	1074	90
	NBC06221	91,867	25,892	36,209	3175	52	393	792	96
	NBC08341	108,998	42,942	45,516	4098	97	406	791	314
	YBC11591	113,882	9129	42,156	3149	25	539	1044	846
	NBC08345	135,257	19,238	47,325	4294	38	418	955	179
	RBC00739	115,582	21,394	48,203	4128	34	393	1330	906
	NBC08328	120,127	24,977	50,709	4282	72	401	1721	660
	NBC08347	112,046	30,931	49,637	4401	59	363	936	390
	YBC07522	128,748	19,091	48,639	4053	47	390	1371	219
	NBC08324	128,142	22,030	49,060	3969	60	373	1323	398
	NBC08338	126,564	21,065	47,543	4105	41	431	1828	227
	NBC08395	125,486	29,092	46,075	4079	56	409	1104	317
	NBC08329	120,924	22,419	47,489	4124	58	391	897	260
	NBC08330	120,160	22,190	48,817	4183	39	397	965	775
Boghazkoy	NBC11779	37,057	31,654	53,746	7336	116	243	1252	100
	NBC11782	36,493	18,345	52,786	6377	72	240	1657	97
	NBC11786	30,042	49,982	50,018	5878	136	270	1069	96
	NBC11795	23,457	40,997	65,371	7956	135	156	1202	100
	NBC11798	17,348	39,821	46,548	6388	120	233	922	96
	NBC11802	23,458	22,814	60,513	6871	82	197	3333	97
	NBC11827	22,708	36,192	40,095	5713	117	127	944	93
	NBC01648	33,538	32,148	58,363	7028	112	238	2744	105
	NBC01879	38,897	35,724	59,666	6754	129	176	1097	99
	NBC01910	16,798	43,396	45,618	5826	128	175	1358	96
	NBC03940	20,738	21,867	55,505	7297	83	205	936	97
	NBC03945	13,920	44,277	47,245	6159	125	212	1450	95
	NBC03991	27,940	41,718	49,029	6238	140	274	1244	97
Dilbat	MLC00332	114,382	33,646	57,124	4688	68	413	1410	107
	MLC00488	112,619	25,863	58,846	4959	60	429	1872	126
	MLC00496	111,490	45,922	58,834	4781	60	718	1917	113
	MLC00597	129,206	17,691	57,395	4870	58	431	1565	112

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	MLC01783	62,294	52,133	63,699	4950	75	383	1693	126
	MLC01786	91,868	34,462	59,099	4988	67	376	1180	144
	YBC11336	157,427	26,905	44,184	3788	57	539	926	136
	YBC11388	104,355	23,720	54,899	4775	48	420	1509	130
	YBC11400	133,418	18,514	58,609	4962	27	412	1400	116
	MLC00367	52,778	24,328	47,418	5538	59	371	949	96
	MLC00375	99,022	40,824	45,138	4318	52	424	1301	95
	MLC00523	111,726	23,986	50,566	4290	62	392	2304	102
	MLC01195	114,696	33,087	52,857	4479	55	633	1197	193
	MLC01782	101,635	28,913	44,701	3898	51	404	965	96
	NBC08388	97,100	28,163	46,855	4096	53	328	788	97
	MLC00444	130,885	21,621	45,531	3903	49	478	1765	274
	MLC01293	61,274	49651	56,368	4253	73	228	1111	304
	MLC01699	99,962	38,556	41,301	3393	54	313	814	177
	MLC01399	107,540	18,502	35,285	2942	47	362	813	195
	MLC01324	103,749	47,816	49,604	4802	46	604	1687	247
Kish	YBC05952	140,782	16,129	52,681	4681	55	375	1384	121
	YBC05893	81,996	3004	27,993	1618	54	336	647	94
	YBC05875	73,629		17,065	1211	41	398	472	92
	YBC05888	77,999	22,476	50,202	3932	43	397	1879	95
	YBC05938	158,033	12,085	49,816	4147	38	371	958	131
	MLC00913	154,531	21,174	29,283	2247	57	586	1085	93
	YBC05878	82,837	9620	39,175	3043	44	376	1989	94
	YBC05892	19,015	12,581	49,815	4211	32	815	1210	112
	YBC05858	82,196	10,777	34,401	2630	43	330	647	94
	YBC05900	138,809	15,221	58,994	4646	46	384	1166	125
	YBC05981	94,709	13,053	38,163	3078	48	274	1020	94
	YBC07981	137,876	15,917	55,690	4560	40	396	1147	133
	YBC05861	61,895	2848	24,989	1979	45	264	606	93
	YBC05869	71,474	8930	31,383	2440	42	364	717	94
	YBC05899	30,826	630	16,511	1255	37	295	941	92
Nimrud (Tablets)	ND278	110,341	31,360	35,108	2943	76	1027	659	82
	ND401 + ND402	126,616	24,329	30,608	3136	51	1147	811	87
	ND403	145,984	27,802	32,398	4928	32	267	1495	102
	ND404	120,151	28,069	30,849	3383	55	544	754	83
	ND405	74,328	35,415	38,537	3812	61	352	2225	102
	ND406 (a)	92,301	34,342	37,229	3233	66	846	973	94

Continued

	ND409	134,779	26,622	26,221	2965	43	587	809	66
	ND411	111,987	29,104	34,314	3271	54	318	1542	88
	ND412	85,090	30,826	38,532	3831	60	372	1723	122
	ND416	11,452	32,485	34,438	3048	64	943	1883	95
	ND423	108,998	28,342	33,782	2930	66	463	1341	85
	ND425	128,034	34,990	33,842	3898	50	246	1237	111
Nimrud (Sealings/bullae)	ND10036	148,290	24,035	32,889	3345	53	619	2338	1260
	ND10038	168,269	22,757	30,137	3163	49	743	1000	910
	ND10001	62,043	23,097	41,550	4388	56	289	3176	1904
	ND10004	93,937	22,542	37,015	3979	53	321	4109	1441
	ND10008	93,751	24,800	39,015	4015	56	352	3394	1653
	ND10009	209,269	20,576	24,646	2579	48	861	1600	679
	ND10010	205,433	23,172	27,503	2552	45	453	1094	1235
	ND10015	211,215	22,293	26,728	2501	42	401	2498	1293
	ND10020	123,828	23,657	31,898	3016	60	529	1153	1961
	ND10024	137,602	21,174	34,708	3214	54	414	714	1688
	ND10025	130,649	24,400	33,433	3909	50	500	2436	1257
	ND10026	131,081	22,766	29,137	3706	51	491	4366	1185
	ND10032	129,189	29,112	32,057	3462	54	459	1695	1802
	ND10035	106,387	27,781	35,694	4100	51	564	3174	2338
	ND10039	138,699	24,074	30,124	3417	50	465	1946	1343
Nineveh (Tablets)	K327	127,865	22,567	38,280	2525	52	261	1697	77
	K332	106,393	23,205	36,007	3718	51	423	2406	80
	K333	51,824	24,849	37,725	4317	48	228	1055	81
	K334	137,476	35,716	30,558	3105	44	482	1181	71
	K335	135,252	36,471	32,660	3439	35	340	1043	70
	K337	168,306	23,012	26,236	2596	37	343	2080	70
	K338	174,367	54,322	30,397	3243	38	388	672	75
	K339	126,255	38,356	35,623	3477	52	733	729	88
	K340	168,324	24,731	28,184	2754	47	578	849	97
	K341	84,081	36,295	42,446	4807	57	453	748	64
	K343	55,039	46,094	68,147	5568	65	344	1974	163
	K346	114,733	33,330	45,314	4806	52	346	845	69
	K347	147,172	24,187	30,054	3049	43	223	1413	76
	K349	136,454	28,373	31,477	3307	38	339	904	84
	K350	70,140	60,375	54,875	4335	73	362	998	106

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Nineveh (Sealings/bullae)	K19661	240,033	23,376	27,621	2382	34	371	571	309
	K19665	250,028	22,006	24,859	2111	41	363	970	339
	K19655	123,444	53,073	37,346	5419	52	1134	1491	589
	K19690	185,450	23,917	25,617	2852	29	428	627	756
	K20051	93,325	54,114	40,226	4979	31	826	1329	426
	K20579	128,388	48,889	30,355	2759	39	405	926	82
	K20580	134,309	37,825	30,605	2669	45	516	860	82
	K20581	132,023	25,388	29,310	2783	53	334	652	75
	K20582	144,748	23,714	27,582	2999	34	281	893	57
	K20577	149,609	18,614	29,491	1793	63	237	2171	75
	K20578	183,546	31,073	29,046	2760	31	432	755	68
	K20575	142,553	29,693	29,659	3023	39	356	646	71
	K20576	138,985	54,320	30,218	2887	36	447	1466	76
	K20573	163,327	23,283	21,442	1716	35	373	1162	61
	K20574	153,588	14,353	21,124	2249	33	260	444	35
Alalakh (Tablets)	131455	223,549	32,147	34,897	2602	40	708	1368	776
	131457	181,190	20,297	40,563	3490	95	726	1113	612
	131458	259,481	36,624	31,359	2276	32	865	1148	849
	131459	173,315	29,608	42,294	3551	35	822	1014	1652
	131460	163,543	42,157	38,637	5142	45	233	1347	964
	131462	213,448	28,386	34,309	2637	32	670	790	1009
	131454	144,836	35,997	44,748	3830	40	933	1872	912
	131477	260,596	16,218	24,890	2010	29	586	683	924
	131478	235,981	14,733	26,924	2306	35	500	2300	1465
	131482	252,153	20,901	27,353	2209	42	629	937	2321
	131484	291,523	11,615	27,837	2003	28	783	725	834
	131486	204,533	16,576	28,784	2462	32	524	1516	796
	131496	249,107	26,049	37,166	2581	36	847	668	777
Tell Halaf (Tablets)	115010	118,469	28,865	30,949	3094	55	267	649	75
	115009 + 115002	119,559	29,086	33,156	3908	55	299	711	86
	115008	115,730	31,845	37,882	4073	53	222	857	81
	115007	135,151	27,534	33,108	3511	47	327	1037	73
	115006	114,615	34,499	34,430	4106	59	335	906	82
	115004	111,203	30,218	33,775	4014	57	282	944	72
	115003	116,845	29,192	36,731	2771	73	260	643	84
	115001 + 115005 + 114998	130,787	21,007	26,632	2508	50	441	507	64

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	115000	107,076	26,986	30,328	6232	58	359	727	76
	114999	131,371	26,693	27,602	2861	52	292	594	63
Tell Brak (Tablets)	131,759	126562	35,795	32,404	3694	54	278	1739	1251
	131,758 + 125,922	118,108	37,878	34,921	3660	62	343	5971	714
	131,739	100,639	37,273	37,206	3445	66	663	592	995
	139,751	119,984	26,401	24,655	2178	52	517	538	85
	126,500	114,844	41,581	33,411	3042	64	625	809	101
	131,753	128,118	53,167	27,289	2768	50	631	862	651
	131,757	273,330	17,570	18,733	1721	23	306	481	721
	131,756	258,030	23,203	22,763	1937	47	3122	513	1469
	131,755	132,256	28,517	31,986	3207	56	857	687	1715
	131,754	115,169	37,820	33,023	3239	61	570	1353	2946
	131,752	118,453	38,671	33,267	3282	64	409	838	1059
	131,751	132,730	38,837	33,016	3234	62	530	2442	672
	131,749	129,110	39,603	32,964	3159	58	537	2651	2533
	131,748	158,624	40,684	31,018	2835	51	463	1357	996