Social Practice and the Exchange of Metals and Metallurgical Knowledge in 2nd Millennium Central Asia

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Dedicated to Evgenij Nikolaevich Chernykh on the occasion of his 85th birthday

Keywords
Central Asia, Bronze Age, Andronovo, metals, provenance studies, lead isotope analyses (LIA), trade and exchange

Abstract

The current article discusses the Bronze Age metal evidence in Central Asia based on a vast study of metals of Kazakh origin in order to better understand what Chernykh once called the West-Asian-Metallurgical Province (WAMP). Based on typological studies it became obvious that typologies do not sufficiently help to understand the distribution patterns of Bronze Age metals in regard to their social nor their economic background. The authors therefore propose an anthropological and theoretical approach that allows the exploration of the practice of exchange within steppe communities based on provenance studies of metals using elemental and Pb-isotope data. These data have been analysed within a research project carried out with Kazakhstan partners between 2004 and 2014. For the first time, a selection of data are presented that support some of the general interpretations of exchange modes between the Petrovka Early Bronze Age and the Late Bronze Age. Especially during the second millennium, it seems that the exchange pattern of metals had changed from single high valued items to a larger scale trade, which included metal transport as well. It is suggested that although the practice of exchange modes between the steppe communities change to larger scale metal exchange during the 2nd half of the 2nd millennium BC, most of the social background still remained similar in comparison to the earlier periods.

Introduction

When looking at the vast field of Chernykh's West-Asian-Metallurgical Province (WAMP) (e.g. Černych, 2013) it is obvious that pure typological studies cannot help when differentiating the various patterns of Bronze Age relations, neither between regional groups, nor within a large distant exchange network. It is a very striking matter of fact that since the later phases of the Early Bronze Age and the beginning of the Middle Bronze Age the metal inventory followed similar technical and formal aspects. Some of best examples are the tin bronze objects of the Sejma-Turbino phenomenon but similar overarching patterns can be noticed for metal inventories of the Andronovo-cultural groups and even in the 2nd half of the 2nd millennium. Besides that, metal composition and provenance-studies have not been carried out on a large scale. Older research attempts since the 1940's allow a picture of a manifold exchange of metals and objects between various regions (Figure 1, see Stöllner, et al., 2013). Such a pattern had possibly to do with multifaceted social practice between semi-mobile and rather sedentary groups. It was especially Michael Frachetti who pointed to the importance of ecological zones as corridors of communication and exchange (e.g. Frachetti, 2008; 2012). Such patterns of practice was usually followed either by the composition of metals or by composition of metal inventories. A second research question is to understand if there was a difference between the earlier and the later phases of the 2nd millennium metal exchange: Hoards and metal deposits from the Late Bronze Age, for instance, enable insights into social actions in which such assemblages were acquired, treated and divested by single groups. It is to be said that we principally acknowledge hoards as well as single artefact deposits as an expression of complex social interactions rather than as results of treasure hoarding (e.g. Fontijn, 2002; Hansen, 2005; Bradley, 2013). If the societal interaction with metals enhances our understanding about how groups did interact, they must be part of our interpretative models on how metals and objects may have been transferred between regions and groups.

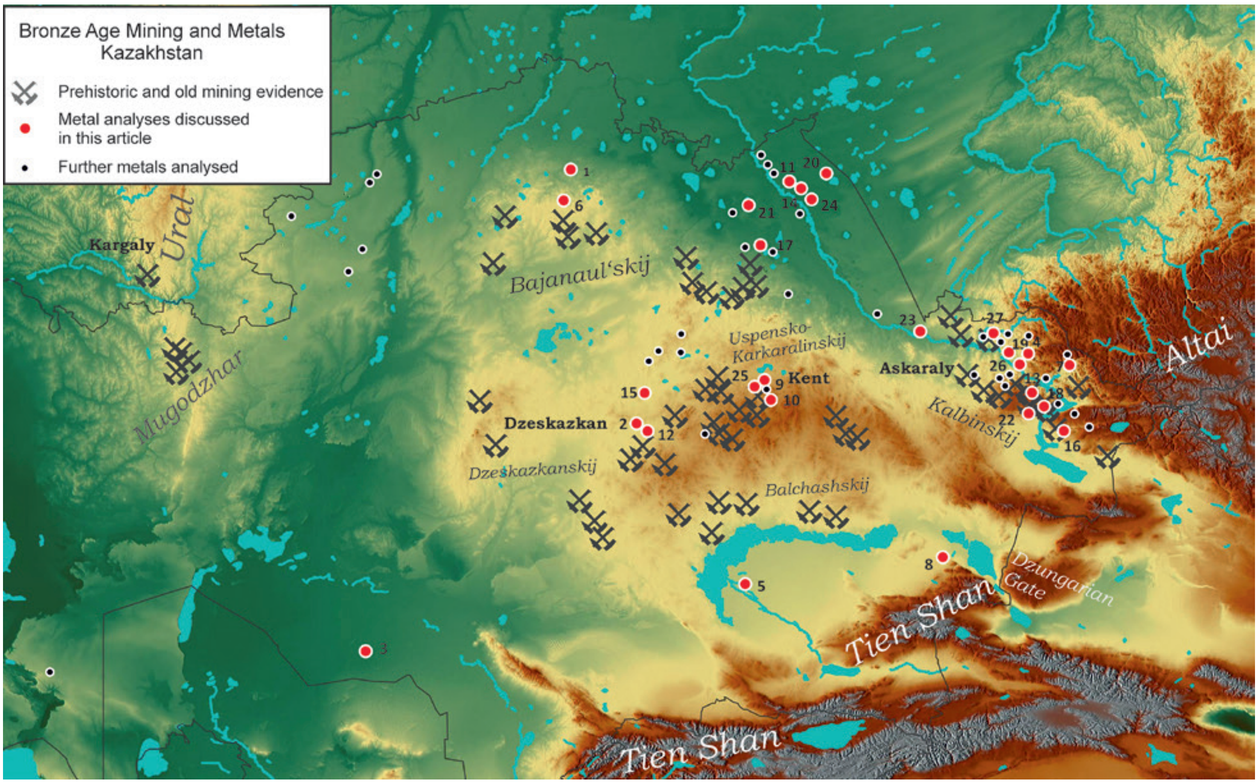


Figure 1. The work area: Central-, South- und East-Kazakhstan and its mining and metallurgical evidence of the later Bronze Age (2^{nd} millennium BC); source: DBM/RUB, Th. Stöllner on the basis of Stöllner and Samashev (2013) and Garner (2014); sites numbering (see tables 1-4): 1. Ashisu, 2. Atasu 1, 3. Baganaly, 4. Bobrovka, 5. Bosingen, 6. Chaglinka, 7. Izmajlovka, 8. Kabanbaj, 9. Karkaralinsk, lake Bolschoje, 10. Kent, 11. Kenzekol 1, 12. Kojschoky 2, 13. Maloe Krasnojarka, 14. Mitchurino 1, 15. Nurataldy 1, 16. Kurchum (hoard), 17. Nurmambet, 18. Palatzy, 19. Predgornoje, 20. Scherbakty, 21. Schiderty 3, 22. Semijarskoe, 23. Semipalatinsk, 24. Sovchose Pavlodarskij, 25. Tasyrbaj, 26. Ust Kamenogorsk, 27. Ust` Talovka.

A theoretical frame of artefact based studies

When archaeologists think about the material world of ancient societies, this incorporates also basic problems of our archaeological record. Our arguments are based on artefacts rather than on people, and all the motivations and archaeological filters lay between prehistoric practices and actions and our interpretation. As being far from a solution for this fundamental dilemma, we just want to argue with the French sociologist Émile Durkheim (Durkheim and Mauss, 1903, pp.55-57) that a society orders the world of things on the pattern of the structure that prevails in the social world of its people (see a comment by Kopytoff, 1988, p.90). But how far can we go within our daily practice in archaeology? What has to be regarded as fluid, what as stable in regard to how societies actually viewed objects as part of their daily life and their mental constructions?

When regarding Central Asian Bronze Age archaeology it has been the basic practice to match objects tightly to groups and societies, often in a way that archaeological objects are handled as if they once have lived. Archaeologists deal with them similar to living people: objects move, they embody prestige, they seem to be envisaged as some kind of actors. This of course is not what Durkheim meant: But it is still today a basic requisite of interpretations. We take just two as examples to remind us: E. E. Kuz'mina undertook major efforts to argue with material compounds as 'tribes' in order to discuss migration patterns for instance of the Andronovo cultural compound (e.g. Kuz'mina, 2001; 2007). Although we still know little about the migration practice of the bearers in the first half of the 2^{nd} millennium, the picture of steppe and forest-steppe people that were on move with their herds did strongly influence our interpretative models (e.g. Frachetti, 2008). It is some kind of explanation that even E. N. Chernykh (1992; recently 2013) had in his mind when he explained the huge expansion of what he calls the Eurasian (EAMP) or West-Asian Metallurgical Province (WAMP).

Given the fact of that they were small scale societies, it is a basic question how to understand the background of their exchange patterns. What however has to be asked first is how we can explain such a huge field of exchange, especially in the later phases of development where we find similar metal objects in a vast distribution over

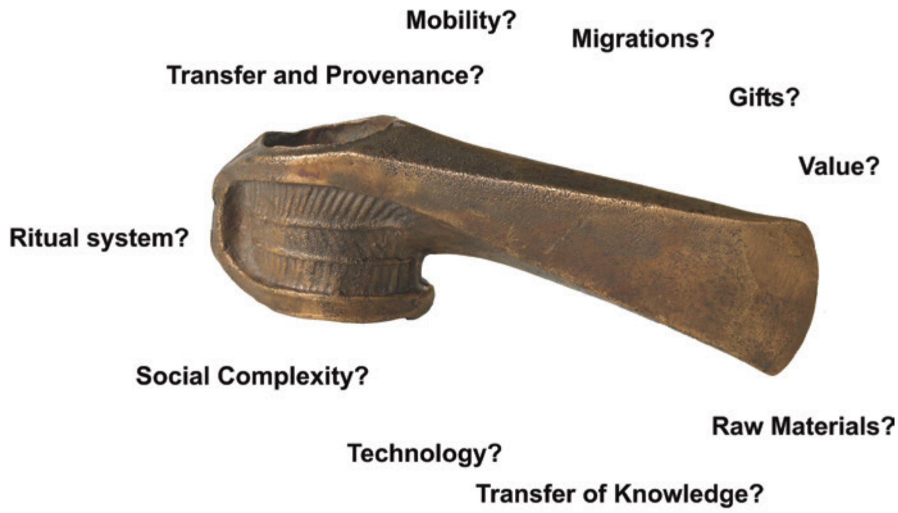


Figure 2. Observation levels to unravel complex social and economic relation inherited to a metal object; source: DBM/RUB, Th. Stöllner, Photo: DBM, M. Schicht.

some thousands of kilometres (e.g. the Sejma-Turbino bronzes). We simply may explain vast distributional patterns with migration and mobility. Nonetheless, it seems this pictures is strongly influenced by the depositional practices of the Central Asian communities. Central Asia is an area where we find depositions especially in burial contexts but also in a comparatively low quantity when comparing the Caucasus and the European conditions (Černych, 2013, pp.196-197, fig. 12): Chernykh's simple but effective statistics demonstrates how difficult it would be to deduce a genuine picture about metal as a trade commodity within these steppe communities. With other words: A realistic picture about the original quantity of objects used during the 'life worlds' of Central Asian societies is unreachable.

Let us come to some further theoretical considerations: If dealing with objects, it is no doubt helpful to understand more about the biographical life-circle of those objects, as Svend Hansen (Hansen, 2013, pp.139-140, fig. 2) has nicely displayed it recently. It is a life-cycle that includes the production and also the consumption of the object with various aspects that charge the idea of an object. Something that is connected also with a certain memorisation, such as the quarry from which the raw material was exploited or the famous craftsperson who made the object. Special objects might have been handed down over generations and its history has been memorised because they had a special function in important actions or ritual practices within the lineage or the clan. They might even become substitutes for the practice or for the ancestors: they acquired by themselves a special agency[1].

The life-cycle of an object is certainly a part of its complex social agency that it has within the cultural perception of things within societies: As Igor Kopytoff (1988, pp.64-65) has stressed nearly 30 year ago with his famous 'slave' example, a person as a slave can become a property, a thing, by commoditisation, and *vice versa* a social being within a household again – though in lower rank.

If regarding Kopytoff's concept of object biographies (1988, pp.66-67; see also Hahn, 2005, p.44, diagram 2), archaeologists are able to understand at least some of the various stages between the production, the consumption, and the final depositions of single objects – and under advantageous circumstances also the embedding into social performances and into societies. Several dimensions are passed down to objects and their archaeological contexts: A systematic approach can help to unravel them (Figure 2). By adoption, there is a constant redefinition and embedding into the social system. Kopytoff (1988) has highlighted the renewing and change of things by 'commoditisation' and 'singularisation'.

While the first leads to extensive social practice of exchange and some kind of 'equivalence' of value, such as food or daily goods or money, one can also observe the opposite: Either by laws, by its singularity, or even because there is some cultural offence against a wide homogenisation. This leads to singularisation, such as to special perceptions of objects by regarding them as sacred, prestigious or especially worthy. It is, in other words, a 'charging' of the objects, which likely could have been immaterial. In the end, the handling of objects always ranges between a general commoditisation and a singularisation that most likely was triggered also by a special biography of single objects.

What Kopytoffs observations did make clear to us is this: It is a constantly changing system of cultural perceptions, which could change quite often in space and time.

What was once a pure commodity obtained, by a certain practice of exchange and a storyboarding, status as a highly valued artefact: This could even include further objects within broader pattern of actions: for instance if foreign objects of a certain shape, story and quality became a desirable and prestigious good. However, as we as archaeologists are not able to decide *a priori* about such processes, as it is hard to understand not only the 'life-cycle' of an object but also the social perception behind it.

The only way to give such questions a better frame is to find out about spheres of action in which objects were embedded. 'Foreignness' and the special quality of object series is therefore one element; the practice of consumption in a special cultural setting (such as a grave-good) is another.

Methodological approach

Whether metal objects were common, or rather specific and exclusive, as being not part of common daily practice, cannot really be argued yet, although there are Bronze Age object groups whose special shape and quality may indicate such specific and exclusive uses.

However, there can be other arguments to help us in this regard: It is the 'foreignness' or the special mode of fabrication, or even the special shape of artefacts that hint at a special life cycle. Such observation - perhaps in combination with an especially long-life usage - may help to explain a single or even a broader 'singularisation' within an artefact group.

If 'singularised' objects became a commodity of exchange, for instance for cattle or other goods, this would lead to a kind of specific devaluation within a community, but they would still keep a broader general or material value. Things may become part of daily practice, no longer kept beyond that and valued only as a commodity. Treatment and depositional practice can help to recognise such a commoditisation[2].

During the recent years, the Bochum research group did intensive work on metals from Bronze Age Kazakhstan. Beginning in the mid-2000's, a series of projects have been undertaken exploring aspects of metals and societies, and the present study represents a branch of this research, the systematic investigation of Bronze Age copper alloys, which has led to PhD thesis now being prepared for publication. A selection of sites and artefacts will be discussed here (Figure 1, Tables 1-5)[3]. Having analysed nearly 400 metal artefacts, it was clear right from the beginning that we would deal not only with metal composition and provenance but also with the artefacts contexts and typology to bring the analyses to a wider contextual level of interpretation (Figure 2). Ore and samples of slags as well as ingots have been included to understand more about the regional variation in provenance and technology (see Stöllner, et al., 2013). For our approach we were combining typological and chronological information about the artefacts and comparing them with chemical and geochemical information according to metal composition and provenance[4].

Elemental and Pb-isotope data from all the sites mentioned and ore from eastern and north-eastern Kazakhstan have been collected between 2006 and 2014 (Figure 3). Pb-isotope data from the Tian Shan, Ural and Altai Mountains as well as Central Kazakhstan are from literature (Syusyura, et al., 1987; Chiaradia, et al., 2006; Box, et al., 2012). Elemental analyses have been performed in the laboratories of the Deutsches Bergbau-Museum Bochum (DBM) with inductively coupled plasma optical emission spectrometry (ICP-OES) up to 2008 (Prange 2001, p.98, fig. 83-84 for procedure) (with /06 laboratory-numbers), from 2009 with ICP-mass spectrometry (ICP-MS) (Kiderlen, et al., 2016, p.305 for procedure). Detection limits of both methods are shown in Prange (2001, p.24, tab. 4). Pb-isotope analyses from 2006 to 2009 have been done with thermal ionisation mass spectrometry (TIMS) in the Institut für Mineralogie, Zentrallabor für Geochronologie in Münster (Bode, Hauptmann and Mezger, 2009, pp.186-188 for procedure) (laboratory numbers /06), and from 2009 with multi-collector-ICP-MS (MC-ICP-MS) at the Institut für Geowissenschaften in Frankfurt am Main (see Klein, et al., 2009, pp.62-64).

Concerning the analytical interpretation of data, there are limitations that are related to methodological aspects in general but also with the way sampling was performed and the acquisition of a database. In Central Asia there is a high variation of deposits from different geological ages (overview, see Seltmann, 2013): there are the Ural Mountains and the comparatively old Altai Mountains in the East but also the Tethyan-Eurasian Metallgenic Belt (TEMB)-girdle in the south (the Tien Shan and Pamir: Seltmann, et al., 2011); there is great variety of Proterozoic and Paleozoic cratons that were mobilised during the Variscan orogeny. Such geological basements stretch from the southern Urals to the Central and East Kazakhstan basements (such as the Kalba Narym-Zone, the Valerianow zone in the West, the Altai-Sayan Uplands and the Central Kazakhstan/Karakum-Zone in the centre) (see Zonenshain, Kuzmin and Natapov, 1990; Nikichenko, 2002).

Table 1. Elemental concentrations from high tin copper-based alloys from Kazakhstan, source: DBM/RUB. The analytical data have been normalised to 100 %.

Lab. no.	Inv. no. KZ-	Site	Artefact	Sn	As	Pb	Fe	Zn	Ag	Au	Sb	Bi	P	S	Co	Ni	Se	Te	Hg	Cu	Total
Tin-bronzes, late 3rd and around BC 2000, East-. Central and Northeast-Kazakhstan																					
4293_14	692	Semipalatinsk	spearhead	9.65	0.395	0.08	0.135	0.036	0.031	0.007	0.005	0.036	0.004	3.33	0.002	0.008	0.030	0.016	0.001	86.46	100
4749_10	306	Schiderty 3	sock.chisel	11.89	0.024	0.87	0.021	0.018	0.018	0.000	0.005	0.001	0.012	0.065	<0.001	0.004	<0.001	0.001	n.a.	86.70	100
4328_14	643	Michurino 1	dagger	12.20	0.220	3.70	0.260	0.060	0.195	0.001	0.054	0.130	0.576	1.076	0.009	0.038	0.004	0.022	0.001	81.68	100
4307_14	645	Michurino 1	dagger	11.83	0.210	2.95	0.053	0.016	0.179	0.002	0.047	0.032	0.026	0.105	0.026	0.040	0.004	0.016	<0.001	84.66	100
4396_14	652	Nurataldy 1	dagger	11.23	1.650	0.15	0.005	0.005	0.038	0.002	0.016	0.176	<0.001	0.395	0.001	0.093	0.022	0.027	0.001	85.96	100
4399_14	680	Nurataldy 1	sheet metal/ingot	16.88	2.648	0.21	0.003	0.004	0.156	0.002	0.004	0.325	0.312	2.078	0.006	0.004	<0.004	0.026	<0.001	77.32	100
4398_14	731	Nurataldy 1	awl	10.34	0.670	1.52	0.007	0.005	0.017	0.005	0.017	0.140	<0.001	0.06	<0.001	0.035	0.008	0.025	0.001	86.80	100
Tin-bronzes Andronovo period, 1st half of 2nd millennium BC, East-, Central and Northeast-Kazakhstan																					
4678_10	235	Ust` Talovka.	dagger	10.63	0.120	0.39	0.007	0.041	0.031	n.a.	0.003	0.002	0.002	0.101	<0.001	<0.001	0.001	0.001	n.a.	88.66	100
4716_10	273	Nurmambet	bead	13.36	0.009	0.05	0.026	0.001	0.039	n.a.	0.001	0.007	0.022	0.022	<0.001	<0.001	<0.001	0.003	n.a.	86.46	100
4352_14	616	Kojschoky 2	bracelet	14.73	0.030	0.372	0.008	0.007	0.029	0.001	0.023	0.046	0.156	1.726	0.004	0.020	<0.004	0.020	0.003	82.83	100
4272_14	612	Baganaly	bracelet	1.848	n.a.	0.036	0.007	0.002	0.018	17.15	<0.001	0.003	0.184	0.757	0.006	0.020	<0.004	0.017	<0.001	79.95	100
Tin-bronzes 2nd half of 2nd millennium BC, East-, Central-, Northeast-, South-Kazakhstan																					
4624/06	216	Palatzy	bracelet	9.71	0.262	0.501	0.007	0.153	0.151	n.a.	0.301	n.a.	0.005	0.05	n.a.	0.009	n.a.	n.a.	n.a.	88.85	100
4752_10	309	Semijarskoe	dagger	10.99	0.090	0.08	0.022	0.008	0.025	n.a.	0.040	0.029	0.003	0.064	0.005	<0.001	<0.001	0.004	n.a.	88.64	100
4679_10	236	Maloe Krasnojarka	spearhead	10.72	0.095	0.016	0.199	0.007	0.051	n.a.	0.025	0.015	0.003	0.066	0.005	0.002	0.001	0.003	n.a.	88.79	100
4681_10	238	Predgornoje	spearhead	14.05	0.052	0.165	0.002	0.001	0.033	n.a.	0.030	0.004	0.002	<0.001	0.001	0.002	<0.001	0.001	n.a.	85.66	100
4753_10	310	Semijarskoe	knife	12.83	0.068	0.232	0.005	0.003	0.032	n.a.	0.013	0.002	0.003	0.005	0.003	0.010	<0.001	0.003	n.a.	86.79	100
4684_10	241	Predgornoe	arrow-head	9.87	0.040	0.024	0.001	0.001	0.014	n.a.	0.015	0.004	0.002	0.003	0.006	0.002	0.001	0.001	n.a.	90.01	100
4709_10	266	Izmajlovka	horse-gear	11.35	0.038	0.029	0.014	0.007	0.006	n.a.	0.001	0.003	0.002	0.020	0.003	0.013	<0.001	0.001	n.a.	88.51	100
4294_14	646	Semijarskoe	dagger	12.24	0.132	0.112	0.015	0.040	0.009	0.004	0.134	0.046	0.036	0.022	0.066	0.173	0.009	0.025	0.001	86.94	100
4321_14	701	Bobrovka	knife	11.95	0.549	0.086	0.044	0.062	0.002	0.020	0.447	0.538	0.009	0.048	0.036	0.893	0.112	0.025	0.003	85.18	100
4288_14	747	Semipalatinsk	sickle	10.24	0.025	0.040	0.201	0.009	0.013	0.003	0.003	0.050	0.020	2.314	0.111	0.191	0.007	0.015	<0.001	86.76	100
4748_10	305	Scherbakty	spearhead	11.69	0.006	0.057	0.010	0.004	0.002	n.a.	<0.001	0.002	0.003	0.057	0.007	<0.001	<0.001	0.001	n.a.	88.16	100
4296_14	636	Sovchose Pavlodarskij	dagger	13.61	0.114	0.125	0.426	0.088	0.026	0.001	0.027	0.156	<0.001	0.385	0.052	0.104	0.008	0.047	<0.001	84.83	100
4414_14	654	Kent	dagger	10.46	0.825	0.007	0.010	0.006	0.048	0.001	0.007	0.041	0.002	0.867	0.135	1.044	0.010	0.030	<0.001	86.51	100
4409_14	684	Kent	semi-finished-product	17.46	0.330	0.015	0.016	0.005	0.213	0.007	0.004	0.042	0.069	0.287	0.011	0.234	<0.004	0.027	0.001	81.28	100
4374_14	717	Tasyrbaj	arrow-head	14.11	0.704	0.002	0.011	0.005	0.025	0.005	0.005	0.011	0.079	1.461	0.011	0.433	0.008	0.023	<0.001	83.11	100
4373_14	730	Tasyrbaj	awl	13.04	0.050	0.049	0.062	0.004	0.180	0.002	0.055	0.065	0.630	1.800	0.006	0.025	0.015	0.020	0.001	84.00	100
4413_14	734	Kent	awl	11.36	0.108	0.026	0.005	0.002	0.027	0.004	0.016	0.029	0.062	0.235	0.007	0.322	<0.004	0.029	<0.001	87.76	100
4341_14	738	Central Kazakhstan	awl	9.47	0.077	0.010	0.009	0.004	0.018	0.006	0.013	0.052	0.006	0.264	0.020	0.041	0.015	0.021	<0.001	89.98	100
4415_14	762	Kent	sock.chisel	11.05	0.128	0.006	0.020	0.004	0.071	0.001	0.002	0.020	0.146	1.085	0.970	0.012	0.018	0.061	<0.001	86.41	100
4371_14	763	Tasyrbaj	horse-gear	13.05	0.021	0.009	0.027	0.002	0.006	0.001	0.002	0.025	0.140	0.500	0.008	0.015	0.015	0.025	0.001	86.15	100
4819_10	394	Kent	semi-finished-product	11.58	0.155	0.142	0.001	0.010	0.024	n.a.	0.016	0.006	0.026	0.002	0.006	0.001	0.001	0.001	n.a.	88.03	100
4824_10	399	Kent	spearhead	12.81	0.414	0.03	0.001	0.033	0.036	n.a.	0.212	0.004	0.010	0.001	0.001	0.008	<0.001	0.001	n.a.	86.44	100
4804_10	376	Kent	chisel	16.83	0.121	0.017	0.070	0.003	0.019	n.a.	0.024	0.001	0.004	0.001	0.005	0.040	<0.001	0.001	n.a.	82.86	100
4823_10	398	Kent	knife	9.14	0.870	0.015	0.003	0.001	0.033	n.a.	0.310	0.001	0.002	<0.001	0.001	0.023	<0.001	0.001	n.a.	89.60	100
4713_10	270	Chaglinka	ingot	9.91	0.704	0.030	0.080	0.004	0.029	n.a.	0.140	0.005	0.015	0.060	0.008	0.008	<0.001	0.002	n.a.	89.01	100
4291_14	752	Kabanbaj	sock.axe	12.23	0.052	0.008	0.017	0.005	0.011	0.002	0.002	0.058	<0.001	0.775	0.045	0.069	0.016	0.016	<0.001	86.69	100
4260_14	759	Kabanbaj	sock.chisel	16.83	0.029	0.012	0.027	0.008	0.004	<0.001	<0.001	0.027	0.007	0.349	0.007	0.027	0.008	0.016	0.001	82.65	100
4292_14	760	Kabanbaj	sock.chisel	13.01	0.075	0.046	0.154	0.012	0.045	<0.001	0.005	0.022	0.038	0.278	0.207	0.152	0.016	0.016	<0.001	85.92	100
4256_14	799	Kabanbaj	sock.chisel	12.52	0.025	0.004	0.011	0.065	0.002	0.001	0.004	0.637	0.008	0.424	0.001	0.011	<0.004	0.022	<0.001	86.26	100

Table 2. Elemental concentrations from various copper-based alloys from Kazakhstan used as examples in this article, source: DBM/RUB. The analytical data have been normalised to 100 %.

Lab. no.	Inv. no.	Site	Artefact	Sn	As	Pb	Fe	Zn	Ag	Au	Sb	Bi	P	S	Co	Ni	Se	Te	Hg	Cu	Total
Nurataldy 1. Hoard, early Andronovo period (beginning of 2nd millennium BC)																					
4395_14	KZ-651	Nurataldy 1	dagger	8.48	0.03	0.36	0.004	0.003	0.019	0.0001	0.009	0.013	<0.001	0.016	0.0002	0.004	0.0004	0.002	0.0001	91.11	100
4396_14	KZ-652	Nurataldy 1	dagger	11.23	1.650	0.15	0.005	0.005	0.038	0.002	0.016	0.176	<0.001	0.395	0.001	0.093	0.022	0.027	0.001	85.96	100
4397_14	KZ-653	Nurataldy 1	dagger	10.03	1.57	0.03	0.228	0.016	0.050	0.0001	0.004	0.027	<0.001	0.067	0.005	0.014	0.0004	0.004	0.0001	88.14	100
4399_14	KZ-680	Nurataldy 1	sheet metal/ ingot	16.88	2.648	0.21	0.003	0.004	0.156	0.002	0.004	0.325	0.312	2.078	0.006	0.004	<0.004	0.026	<0.001	77.32	100
4400_14	KZ-681	Nurataldy 1	ingot	0.20	1.01	0.004	0.503	0.011	0.047	0.0002	0.004	0.013	<0.001	0.112	0.011	0.039	0.0004	0.005	0.0001	98.28	100
4401_14	KZ-682	Nurataldy 1	ingot	0.01	0.10	0.05	0.026	0.025	0.022	0.0002	0.003	0.001	0.001	0.112	0.004	0.006	0.0008	0.004	0.0001	99.82	100
4393_14	KZ-694	Nurataldy 1	spearhead	15.19	0.02	0.1	0.020	0.045	0.026	0.00004	0.006	0.003	0.002	0.049	0.001	0.003	0.0011	0.003	0.0001	84.67	100
4394_14	KZ-695	Nurataldy 1	spearhead	1.62	0.01	0.16	0.002	0.003	0.077	0.00004	0.750	0.003	<0.001	0.009	0.0001	0.007	0.0011	0.002	0.0001	97.45	100
4398_14	KZ-731	Nurataldy 1	awl	10.34	0.670	1.52	0.007	0.005	0.017	0.005	0.017	0.140	<0.001	0.06	<0.001	0.035	0.008	0.025	0.001	86.80	100
"Srubnaja"-daggers from Petrovka-, Andronovo periods (first half 2nd millennium and mid of 2nd millennium BC)																					
4677_10	KZ-234	East Kazakhstan	dagger	6.04	0.1	0.02	0.002	0.002	0.023	n.a.	0.015	0.002	0.002	0.031	0.005	0.018	0.0006	0.001	n.a.	93.74	100
4678_10	KZ-235	Ust`Talovka	dagger	10.63	0.12	0.4	0.007	0.040	0.030	n.a.	0.003	0.002	0.002	0.101	0.00001	0.00001	0.0013	0.001	n.a.	88.66	100
4307_14	KZ-645	Michurino 1	dagger	11.83	0.210	2.95	0.053	0.016	0.179	0.002	0.047	0.032	0.026	0.105	0.026	0.040	0.004	0.016	<0.001	84.66	100
4782_10	KZ-354	Bozingen	dagger	4.62	0.04	0.01	0.001	0.002	0.031	n.a.	0.022	0.001	0.002	0.005	0.0003	0.00001	0.0001	0.001	n.a.	95.26	100
4783_10	KZ-355	Central Kazakhstan	dagger	0.94	0.06	0.02	0.001	0.001	0.018	n.a.	0.014	0.004	0.001	0.010	0.0001	0.001	0.0001	0.0002	n.a.	98.93	100
4395_14	KZ-651	Nurataldy 1	dagger	8.48	0.03	0.36	0.004	0.003	0.019	0.0001	0.009	0.013	<0.001	0.016	0.0002	0.004	0.0004	0.002	0.0001	91.11	100
4396_14	KZ-652	Nurataldy 1	dagger	11.23	1.650	0.15	0.005	0.005	0.038	0.002	0.016	0.176	<0.001	0.395	0.001	0.093	0.022	0.027	0.001	85.96	100
4397_14	KZ-653	Nurataldy 1	dagger	10.03	1.57	0.03	0.228	0.016	0.050	0.0001	0.004	0.027	<0.001	0.067	0.005	0.014	0.0004	0.004	0.0001	88.14	100
4430_14	KZ-656	Ashisu	dagger	6.91	0.27	0.23	0.141	0.004	0.019	0.0001	0.004	0.005	0.281	0.153	0.001	0.009	0.0019	0.006	0.0001	92.44	100
4327_14	KZ-642	Kenzekol 1	dagger	9.34	0.02	0.11	0.035	0.005	0.022	0.0004	0.009	0.002	0.220	0.090	0.001	0.004	0.0012	0.001	0.0001	90.48	100
4377_14	KZ-648	Karkaralinsk. lake Bolschoje	dagger	9.60	0.01	0.18	0.008	0.003	0.002	0.00001	0.002	0.001	0.004	0.007	0.001	0.004	0.0004	0.002	0.0001	90.20	100
4347_14	KZ-709	Atasu 1	dagger	2.13	0.04	0.04	0.012	0.009	0.011	0.0001	0.003	0.002	0.006	0.157	0.001	0.027	0.0004	0.001	0.0001	97.78	100
4752_10	KZ-309	Semijarskoe	dagger	10.99	0.090	0.08	0.022	0.008	0.025	n.a.	0.040	0.029	0.003	0.064	0.005	<0.001	<0.001	0.004	n.a.	88.64	100
4781_10	KZ-353	Kent. surroundings	dagger	2.80	0.17	0.04	0.002	0.002	0.032	n.a.	0.082	0.020	<0.001	0.004	0.001	0.00001	0.0001	0.001	n.a.	96.85	100
LBA-hoards of the second half of the 2nd millennium BC																					
4578_06	KZ-170	Predgornoe	sickle	10.55	0.04	0.17	0.012	0.160	0.056	n.a.	<0.001	n.a.	0.02	0.790	n.a.	<0.001	n.a.	n.a.	n.a.	88.20	100
4579_06	KZ-171	Predgornoe	sickle	6.96	0.32	0.14	0.006	0.134	0.064	n.a.	0.116	n.a.	<0.001	0.167	n.a.	0.118	n.a.	n.a.	n.a.	91.98	100
4680_10	KZ-237	Predgornoe	spearhead	4.02	0.07	0.02	0.630	0.007	0.009	n.a.	0.003	0.020	0.002	0.027	0.001	<0.00001	0.002	0.001	n.a.	95.18	100
4681_10	KZ-238	Predgornoe	spearhead	14.05	0.052	0.165	0.002	0.001	0.033	n.a.	0.030	0.004	0.002	<0.001	0.001	0.002	<0.001	0.001	n.a.	85.66	100
4580_06	KZ-172	Kurcumskij hoard	needle	5.63	1.33	0.20	<0.001	0.097	0.030	n.a.	0.001	n.a.	<0.001	0.060	n.a.	<0.001	n.a.	n.a.	n.a.	92.654	100
4581_06	KZ-173	Kurcumskij hoard	knife	12.92	0.056	0.73	<0.001	0.152	0.164	n.a.	0.050	n.a.	0.203	0.697	n.a.	<0.001	n.a.	n.a.	n.a.	85.03	100
4582_06	KZ-174	Kurcumskij hoard	knife	11.2	0.02	0.19	0.300	0.120	0.040	n.a.	<0.001	n.a.	0.030	0.50	n.a.	<0.001	n.a.	n.a.	n.a.	87.60	100
4583_06	KZ-175	Kurcumskij hoard	knife	0.027	0.02	0.15	0.080	0.110	0.040	n.a.	0.003	n.a.	<0.001	0.170	n.a.	<0.001	n.a.	n.a.	n.a.	99.40	100
4584_06	KZ-176	Kurcumskij hoard	knife	8.34	0.26	0.31	<0.001	0.124	0.081	n.a.	0.031	n.a.	0.042	0.277	n.a.	<0.001	n.a.	n.a.	n.a.	90.51	100
4585_06	KZ-177	Kurcumskij hoard	ingot	11.24	1.36	0.38	<0.001	0.057	0.160	n.a.	0.073	n.a.	<0.001	0.590	n.a.	<0.001	n.a.	n.a.	n.a.	86.14	100

Lab. no.	Inv. no.	Site	Artefact	Sn	As	Pb	Fe	Zn	Ag	Au	Sb	Bi	P	S	Co	Ni	Se	Te	Hg	Cu	Total
4586_06	KZ-178	Kurcumskij hoard	awl	7.90	<0.001	0.09	0.050	0.127	0.300	n.a.	<0.001	n.a.	<0.001	0.600	n.a.	<0.001	n.a.	n.a.	n.a.	90.93	100
4587_06	KZ-179	Kurcumskij hoard	awl	5.80	<0.001	0.20	0.044	0.130	0.046	n.a.	<0.001	n.a.	0.030	0.75	n.a.	<0.001	n.a.	n.a.	n.a.	93.00	100
4588_06	KZ-180	Kurcumskij hoard	ingot	5.11	0.08	0.20	<0.001	0.102	0.055	n.a.	0.006	n.a.	0.012	0.107	n.a.	<0.001	n.a.	n.a.	n.a.	94.32	100
4589_06	KZ-181	Kurcumskij hoard	ingot	9.60	0.05	1.42	0.190	0.164	0.042	n.a.	0.0022	n.a.	0.0074	0.270	n.a.	<0.001	n.a.	n.a.	n.a.	88.25	100
4590_06	KZ-182	Kurcumskij hoard	hammer	9.54	0.21	0.27	0.032	0.117	0.055	n.a.	<0.001	n.a.	0.006	0.324	n.a.	<0.001	n.a.	n.a.	n.a.	89.44	100
4591_06	KZ-183	Kurcumskij hoard	dagger	4.53	0.003	0.11	0.058	0.115	0.019	n.a.	<0.001	n.a.	0.008	0.453	n.a.	<0.001	n.a.	n.a.	n.a.	94.71	100
4592_06	KZ-184	Kurcumskij hoard	horse-gear	2.79	0.12	0.13	0.140	0.119	0.028	n.a.	<0.001	n.a.	0.010	0.270	n.a.	0.001	n.a.	n.a.	n.a.	96.39	100
4593_06	KZ-185	Kurcumskij hoard	ingot	9.07	0.27	1.88	0.025	0.125	0.021	n.a.	<0.001	n.a.	0.003	0.145	n.a.	<0.001	n.a.	n.a.	n.a.	88.44	100
4604_06	KZ-196	Kurcumskij hoard	knife	6.18	0.88	0.37	0.010	0.275	0.063	n.a.	0.039	n.a.	<0.001	0.308	n.a.	<0.001	n.a.	n.a.	n.a.	91.88	100
4605_06	KZ-197	Kurcumskij hoard	dagger	2.44	0.41	0.28	0.132	0.120	0.057	n.a.	0.042	n.a.	<0.001	0.162	n.a.	0.029	n.a.	n.a.	n.a.	96.32	100
4606_06	KZ-198	Kurcumskij hoard	knife	7.21	0.35	0.18	<0.001	0.104	0.105	n.a.	0.009	n.a.	<0.001	0.340	n.a.	<0.001	n.a.	n.a.	n.a.	91.70	100
4620_06	KZ-212	Palatzy	hammer	9.795	0.24	0.02	0.033	0.131	0.019	n.a.	0.029	n.a.	0.007	0.074	n.a.	0.055	n.a.	n.a.	n.a.	89.60	100
4322_06	KZ-214	Palatzy	dagger	11.19	0.04	0.62	0.368	0.305	0.040	n.a.	0.009	n.a.	0.026	0.430	n.a.	<0.001	n.a.	n.a.	n.a.	86.98	100
4624_06	KZ-216	Palatzy	bracelet	9.71	0.262	0.501	0.007	0.153	0.151	n.a.	0.301	n.a.	0.005	0.05	n.a.	0.009	n.a.	n.a.	n.a.	88.85	100
4625_06	KZ-217	Palatzy	socketed axe	4.84	0.07	0.24	0.015	0.114	0.030	n.a.	0.005	n.a.	<0.001	0.086	n.a.	<0.001	n.a.	n.a.	n.a.	94.59	100
4626_06	KZ-218	Palatzy	socketed axe	3.76	0.01	2.90	0.087	0.258	n.a.	n.a.	<0.001	n.a.	0.008	0.332	n.a.	<0.001	n.a.	n.a.	n.a.	92.64	100
4291_14	KZ-752	Kabanbaj	socketed axe	12.23	0.052	0.008	0.017	0.005	0.011	0.002	0.002	0.058	<0.001	0.775	0.045	0.069	0.016	0.016	<0.001	86.69	100
4260_14	KZ-759	Kabanbaj	socketed chisel	16.83	0.029	0.012	0.027	0.008	0.004	<0.001	<0.001	0.027	0.007	0.349	0.007	0.027	0.008	0.016	0.001	82.65	100
4292_14	KZ-760	Kabanbaj	socketed chisel	13.01	0.075	0.046	0.154	0.012	0.045	<0.001	0.005	0.022	0.038	0.278	0.207	0.152	0.016	0.016	<0.001	85.92	100
4256_14	KZ-799	Kabanbaj	socketed chisel	12.52	0.025	0.004	0.011	0.065	0.002	0.001	0.004	0.637	0.008	0.424	0.001	0.011	<0.004	0.022	<0.001	86.26	100

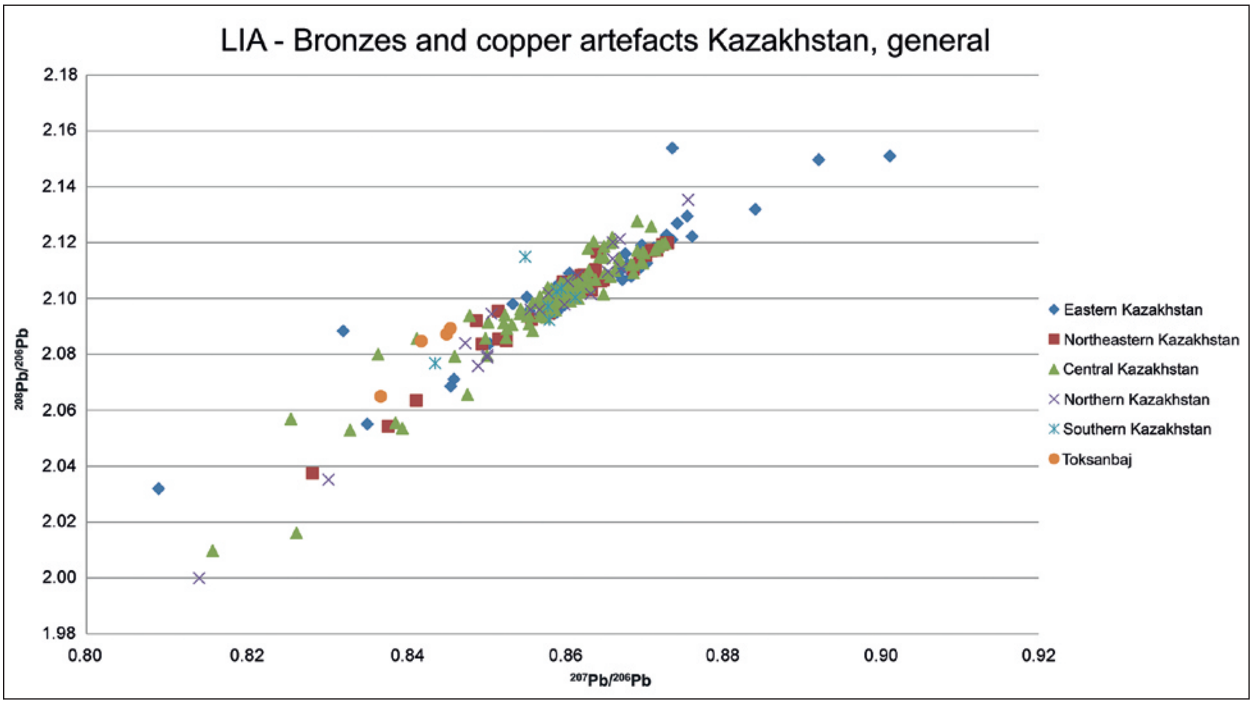


Figure 3. Pb-isotope ratios of 260 metal objects from various regions in Kazakhstan, analysed between 2006 and 2014 in the frame of the joint Kazakh-German project; source: DBM/RUB, M. Bode, A. Gontscharov, Th. Stöllner.

Table 3. Pb-isotope data from high tin copper-based alloys from Kazakhstan, source: DBM/RUB.

Lab. no.	Inv. no.	Site	Artefact	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$
High tin alloys, Petrovka-period/early Andronovo-period, late 3rd/early 2nd millennium BC						
4293_14	KZ-692	Semipalatinsk	spearhead	18.117	0.85815	2.09805
4749_10	KZ-306	Shiderty 3	sock.chisel	18.419	0.84915	2.09200
4328_14	KZ-643	Michurino 1	dagger	18.033	0.86406	2.10894
4307_14	KZ-645	Michurino 1	dagger	18.119	0.86160	2.10625
4396_14	KZ-652	Nurataldy 1	dagger	17.796	0.87212	2.11867
4399_14	KZ-680	Nurataldy 1	sheet metal/ingot	17.954	0.86733	2.11326
4393_14	KZ-694	Nurataldy 1	spearhead	17.801	0.87169	2.11741
4398_14	KZ-731	Nurataldy 1	awl	18.044	0.86333	2.10994
High tin alloys, Andronovo, first half of 2nd millennium BC						
4678_10	KZ-235	Ust`Talovka	dagger	17.735	0.87380	2.12096
4716_10	KZ-273	Nurmambet	bead	18.104	0.86267	2.10849
4352_14	KZ-616	Kojschoky 2	bracelet	18.062	0.86308	2.10821
4272_14	KZ-612	Baganaly	bracelet	18.186	0.85924	2.10244
High tin alloys, Late Bronze Age, second half of 2nd millennium BC						
4624/06	KZ-216	Palatzy	bracelet	17.829	0.87050	2.11537
4752_10	KZ-309	Semijarskoe	dagger	17.832	0.86996	2.11630
4679_10	KZ-236	Maloe Krasnojarka	spearhead	18.022	0.86382	2.10949
4681_10	KZ-238	Predgornoje	spearhead	18.093	0.86011	2.09981
4753_10	KZ-310	Semijarskoe	knife	17.394	0.89231	2.14958
4684_10	KZ-241	Maloe Krasnojarka	arrow-head	17.957	0.86556	2.10828
4709_10	KZ-266	Izmajlovka	horse-gear	18.017	0.86186	2.10091
4294_14	KZ-646	Semijarskoe	dagger	17.881	0.86792	2.11596
4321_14	KZ-701	Bobrovka	knife	17.580	0.88433	2.13185
4288_14	KZ-747	Semipalatinsk	sickle	18.044	0.86026	2.09762
4748_10	KZ-305	Scherbakty	spearhead	18.071	0.85898	2.09825
4296_14	KZ-636	Sovchose Pavlodarskij	dagger	18.019	0.86485	2.10626
4414_14	KZ-654	Kent	dagger	18.269	0.85301	2.08908
4409_14	KZ-684	Kent	semi-finished-product	18.151	0.85720	2.09535
4374_14	KZ-717	Tasyrbaj	arrow-head	18.729	0.83676	2.07997
4373_14	KZ-730	Tasyrbaj	awl	18.295	0.85259	2.09114
4413_14	KZ-734	Kent	awl	18.011	0.86628	2.12180
4341_14	KZ-738	Central Kazakhstan	awl	18.202	0.85623	2.09832
4415_14	KZ-762	Kent	sock.chisel	17.886	0.86896	2.10910
4371_14	KZ-763	Tasyrbaj	horse-gear	18.116	0.85795	2.09323
4819_10	KZ-394	Kent	semi-finished-product	18.165	0.86055	2.10527
4824_10	KZ-399	Kent	spearhead	19.032	0.82578	2.05685
4804_10	KZ-376	Kent	ingot/chisel-fragment?	18.044	0.86292	2.10775
4823_10	KZ-398	Kent	knife	18.245	0.85718	2.10056
4713_10	KZ-270	Chaglinka	ingot	18.220	0.85712	2.09596
4291_14	KZ-752	Kabanbaj	sock.axe	18.090	0.85836	2.09221
4260_14	KZ-759	Kabanbaj	sock.chisel	18.161	0.85532	2.11485
4292_14	KZ-760	Kabanbaj	sock.chisel	18.044	0.86162	2.10031
4256_14	KZ-799	Kabanbaj	sock.chisel	18.445	0.84395	2.07674

Table 4. Pb-isotope data from various copper-based alloys from Kazakhstan used as examples in this article, source: DBM/RUB.

Lab. no.	Inv. no.	Site	Artefact	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$
Nurataldy, early Andronovo period, around 2000 BC						
4400_14	KZ-681	Nurataldy 1	ingot	18.590	0.84166	2.08558
4401_14	KZ-682	Nurataldy 1	ingot	18.066	0.86206	2.10580
4395_14	KZ-651	Nurataldy 1	dagger	17.865	0.87120	2.12577
4396_14	KZ-652	Nurataldy 1	dagger	17.796	0.87212	2.11867
4397_14	KZ-653	Nurataldy 1	dagger	18.047	0.86176	2.10413
4399_14	KZ-680	Nurataldy 1	sheet metal/ingot	17.954	0.86733	2.11326
4393_14	KZ-694	Nurataldy 1	spearhead	17.801	0.87169	2.11741
4394_14	KZ-695	Nurataldy 1	spearhead	18.163	0.85949	2.10007
4398_14	KZ-731	Nurataldy 1	awl	18.044	0.86333	2.10994
"Srubnaja daggers", first half and mid of 2nd millennium BC						
4307_14	KZ-645	Michurino 1	dagger	18.119	0.86160	2.10625
4430_14	KZ-656	Ashisu	dagger	18.077	0.86149	2.10121
4782_10	KZ-354	Bozingen	dagger	18.184	0.85969	2.10345
4783_10	KZ-355	Central Kazakhstan	dagger	17.999	0.86532	2.11458
4395_14	KZ-651	Nurataldy 1	dagger	17.865	0.87120	2.12577
4396_14	KZ-652	Nurataldy 1	dagger	17.796	0.87212	2.11867
4397_14	KZ-653	Nurataldy 1	dagger	18.047	0.86176	2.10413
4676_10	KZ-233	Ust Kamenogorsk	dagger	17.813	0.87077	2.11536
4677_10	KZ-234	East Kazakhstan	dagger	17.879	0.86756	2.10663
4678_10	KZ-235	Ust`Talovka	dagger	17.735	0.87380	2.12096
4347_14	KZ-709	Atasu 1	dagger	18.164	0.86025	2.10506
4377_14	KZ-648	Karkaralinsk,lake Bolschoje	dagger	18.027	0.86626	2.12015
4752_10	KZ-309	Semijarskoe	dagger	17.832	0.86996	2.11630
4781_10	KZ-353	Kent, surroundings	dagger	18.124	0.86010	2.10087
Hoards of the Late Bronze Age (second half of 2nd millenium BC)						
4579_06	KZ-171	Predgornoe	sickle	17.780	0.8715	2.11803
4680_10	KZ-237	Predgornoe	spearhead	17.692	0.87634	2.12216
4681_10	KZ-238	Predgornoe	spearhead	18.093	0.86011	2.09981
4322_06	KZ-214	Palatzy	dagger	18.040	0.8627	2.10805
4624_06	KZ-216	Palatzy	bracelet	17.829	0.87050	2.11537
4625_06	KZ-217	Palatzy	sock.axe	17.839	0.86977	2.11388
4626_06	KZ-218	Palatcy	sock.axe	17.786	0.87175	2.11696
4291_14	KZ-752	Kabanbaj	sock.axe	18.089	0.85836	2.09221
4260_14	KZ-759	Kabanbaj	sock.chisel	18.161	0.85532	2.11485
4292_14	KZ-760	Kabanbaj	sock.chisel	18.044	0.86162	2.10031
4256_14	KZ-799	Kabanbaj	sock.chisel	18.445	0.84395	2.07674

Such preconditions make it difficult to work on geochemical patterns. Pb-isotopes for instance provide only negative evidence, while positive matching is only an indication of the possibility, but not proof. As the geology is complex and does show remobilisation of host-rocks and ores, it is important to know the exact location of a sample within a deposit (Figure 4, upper diagram). Another matter that does not ease the approach is the fact that we could not sample most of the ore deposits (which are restricted especially for Central Kazakhstan) and that not all the landscapes were sampled on a comparative level of detail. Nevertheless, we have achieved the thus far largest series of modern trace-element-studies of metals from Bronze Age Kazakhstan, including a high

Table 5. Pb-isotope data from copper-based alloys from Central Kazakhstan (Kent and Karakalinsk), source: DBM/RUB.

Lab. no.	Inv. no.	Artefact	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$
Kent, settlement, second half of 2nd millennium BC					
4385-14	KZ-627	ingot	18.287	0.85291	2.08592
4390-14	KZ-678	ingot	17.990	0.86469	2.11473
4411-14	KZ-628	ingot	18.216	0.85362	2.09058
4386-14	KZ-674	semi-finished-product	18.340	0.85275	2.09403
4387-14	KZ-675	semi-finished-product	17.762	0.87255	2.11938
4388-14	KZ-676	semi-finished-product	18.223	0.85464	2.09443
4389-14	KZ-677	semi-finished-product	18.564	0.83981	2.05349
4391-14	KZ-679	semi-finished-product	18.034	0.86249	2.10438
4408-14	KZ-683	semi-finished-product	17.781	0.87294	2.11981
4409-14	KZ-684	semi-finished-product	18.151	0.85720	2.09535
4450-14	KZ-673	semi-finished-product	18.087	0.86048	2.10205
4795-10	KZ-367	semi-finished-product	18.143	0.85624	2.08843
4796-10	KZ-368	semi-finished-product	18.089	0.85967	2.09882
4817-10	KZ-392	semi-finished-product	18.573	0.83896	2.05538
4789-10	KZ-361	sickle	18.124	0.85879	2.09795
4790-10	KZ-362	sickle	18.137	0.85839	2.09807
4792-10	KZ-364	dagger	18.488	0.84642	2.07922
4797-10	KZ-369	flat chisel	20.960	0.75117	1.82127
4800-10	KZ-372	gouge	18.087	0.86058	2.10178
4802-10	KZ-374	chisel-fragment	18.206	0.85856	2.10333
4803-10	KZ-375	axe-fragment	18.110	0.85941	2.09868
4804-10	KZ-376	ingot/ chisel-fragment?	18.044	0.86292	2.10775
4806-10	KZ-378	chisel	18.004	0.86524	2.11861
4809-10	KZ-390	pincer	19.141	0.81592	2.00970
4811-10	KZ-391	bodkin	18.108	0.86118	2.10655
4816-10	KZ-392	wire	18.016	0.86594	2.11985
4818-10	KZ-394	semi-finished-product	18.165	0.86055	2.10527
4822-10	KZ-397	dagger	18.296	0.85051	2.07950
4823-10	KZ-398	knife	18.245	0.85718	2.10056
4824-10	KZ-399	spearhead	19.032	0.82578	2.05685
4405-14	KZ-774	slag	18.671	0.83785	2.07452
4410-14	KZ-775	slag	18.099	0.85960	2.10005
Karkaralinsk, settlement, second half of 2nd millennium BC					
4380_14	KZ-625	ingot	18.188	0.85777	2.09764
4381_14	KZ-626	ingot	17.863	0.87012	2.11651

number of lead-isotope data. According to work carried out so far by the by Russian and Kazakh colleagues as well as American and German scholars (e.g. Degtjareva, 1985; Chernykh, 1992; 2013; Hanks and Doonan, 2009; Krause, 2013; Stöllner, et al., 2013; Grigoriev, 2015) there is a reasonable amount of data available that we are able to discuss.

During our work we were able to differentiate regional geochemical patterns that enable a level of discussion according to the 'foreignness' of objects (or their regional embedding), as well as to understand their metal quality and their alloy. There is, for instance, no doubt that tin-rich alloys can be regarded as characteristic for East Kazakhstan (already known in the 1940's: Chernikov, 1949), as elevated zinc-levels are typical for the polymetallic ore-deposits there (Rudnij Altai) (Stöllner, et al., 2013, p.389, fig. 6). On the other hand, elevated arsenic levels can often be observed in metals found in West Kazakhstan, which generally provides a hint for sources in the Mugodzary Mountains and the South Uralian deposits (Zajkov, et al., 2005; Tkačev, Zajkov and Juminov, 2013). In general, the variety of trace elements allows some thoughts of metal groups, but it must be borne in mind that many ore deposits are not sufficiently sampled yet (Figure 4, upper diagram).

Something that did help us to define the regional fields with more accuracy was the discussions of the Pb-isotope characterisation slags, ores, and of raw metals/ metal ingots. Thus we were able to confirm our isotopic fields. The same is true for many of the Kent findings: as Kent is one of the largest sites in Central Kazakhstan (Varfolomeev, 2011), we were able to test its metals, slags and raw materials, thus being able to define a special central Kazakhstan field (like the Uspensko-Karkalinsky-ore-field: Berdenov, 2008; Zhauymbaev, 1985; 2001; 2013) that differs from the Dzezkazgan-copper ore field (Syusyura, et al., 1987), which also lies geographically far away in the west (Malchenko and Ermolov, 2006; Box, et al., 2012)[5] (Figure 4, lower diagram, Table 5).

Discussing the single objects according to their geochemical and metal composition was therefore possible, though not always unambiguous and unproblematic. With attentiveness to the limitations of the methods, we tried to propose a first conclusion when checking three arguments of concurrency. There is, first, the chronological and typological relations between the single objects and regions, evidence that rarely provide a clear answer because the object classes were once widely distributed within special communication corridors (similar to the aspects argued by Frachetti, 2008; 2012). There is, second, the elemental composition and its question of overlapping with chronologically comparable other metals of a region and of course their different composition. In such cases, third, the lead-isotope values provide another argument to support or refute the foreignness of the artefacts. It must be stated here that we rather argue with multiple possible provenances than with clear assignments to specific metal ore deposits, which still is a difficult task.

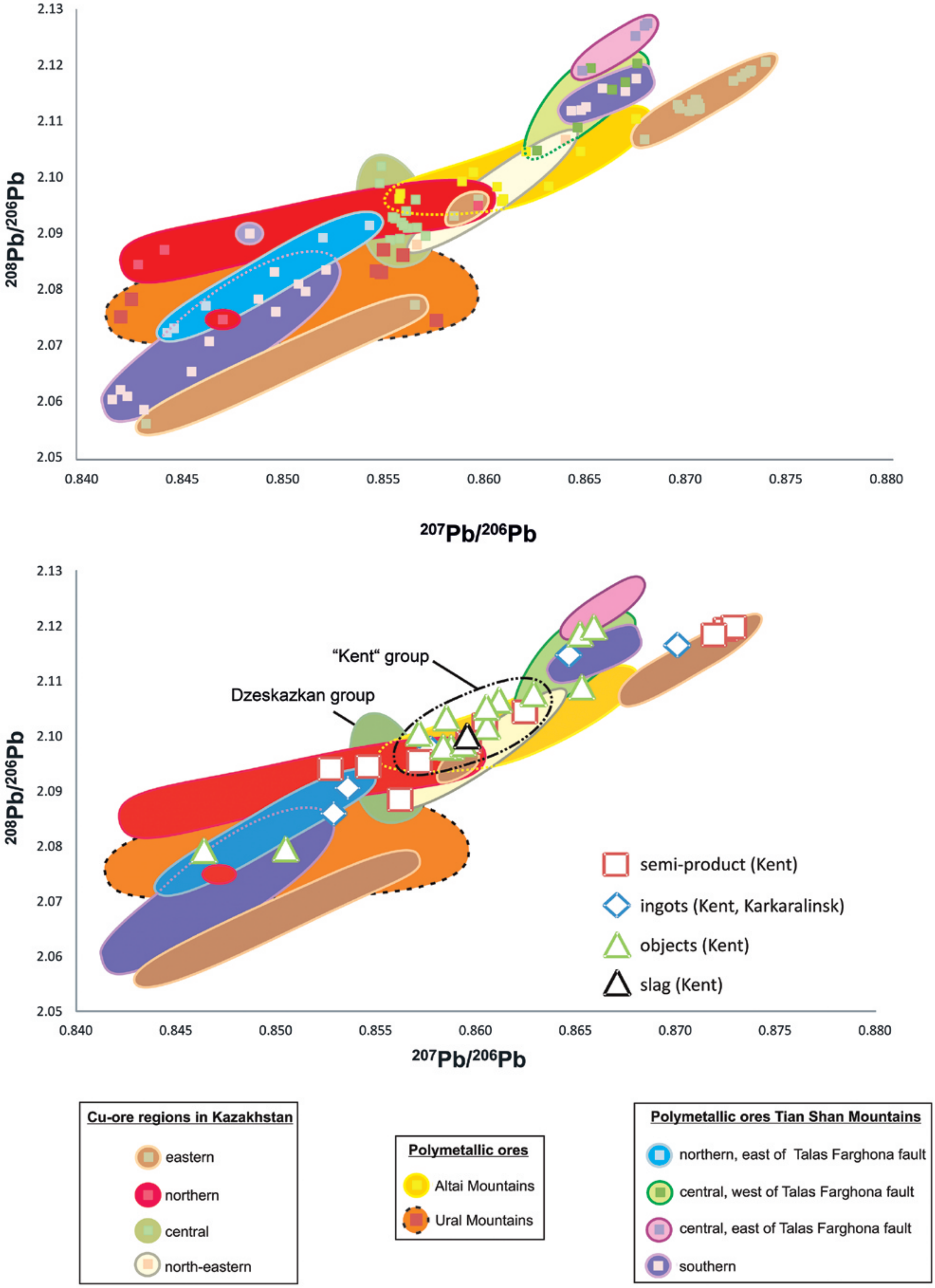


Figure 4. Pb-isotope ratios of ore samples from different Kazakhstan regions and neighbouring ore zones, defined from LIA-data of ores (above) and the definition of a Central Kazakhstan-Kent group on the basis of metals, half-finished products and slags from the Late Bronze Age Kent settlement (below); source: DBM/RUB, M. Bode, A. Gontscharov, Th. Stöllner.

Results

High tin bronzes and the 'Sejma-phenomenon' – the importance of East Kazakhstan

The bronzes of the so-called Sejma-Turbino phenomenon are a perfect example to explore our question concerning social practice and the valuation of objects within a large sphere of exchange[6]. After decades of discussion, it is now widely accepted that most of the artefacts belong to a period from the end of the 3rd millennium until the first half of the 2nd millennium. As Chernykh and Kuz'minykh (1989) have already stated, they seldom occur in graves, but instead in depositions and ritual contexts where the depositional character can be observed, particularly by putting them to the ground or burying them at selected topographical sites. It has been further stated that they display delicate casting technologies and often a high amount of tin, which is outstanding in itself, especially for the typologically earliest examples. The Sejma object assemblage has some variation, which forces us to differentiate between assemblages of Sejma-Turbino character *sensu strictu* and *sensu lato*. Some special daggers, socketed axes and spearheads certainly belong to the first one, others can perhaps only be classified to this group on the basis of their casting quality and some stylistic aspects.

Chernykh and Kuz'minykh (1989) defined three components within the Sejma-Turbino phenonemon: the objects *sensu strictu*, as well as Samus`-Kižirovo objects and Eurasian influenced finds. Samus`-Kižirovo objects are distributed particularly in Western Siberia and has been considered as a further development from physical Sejma-Turbino objects. Chernykh and Kuz'minych underlined in 1989 that Samus`-Kizhirovo- and Sejma-Turbino-objects are not found in combination and they thought about a chronological difference. But newer assemblages from Šajtanskoe Ozero 2 underline at least a synchronous deposition of both object series (Serikov, et al., 2009) [7].

Objects series that were underpinned by a Eurasian component had their origin in East European and South Uralian communities of the late 3rd millennium BC: the Katakombnaja, Abashevo, Sintashta-communities. This includes spearheads with forged slotted socket, riveted daggers with inserted blade (so-called 'Srubnaja'-daggers), but also daggers with central bulge as well as cast spearheads with rhombic square-section (Chernykh, 1992; Černych, 2013). The later can be understood as advancements of Sejma-Turbino types.

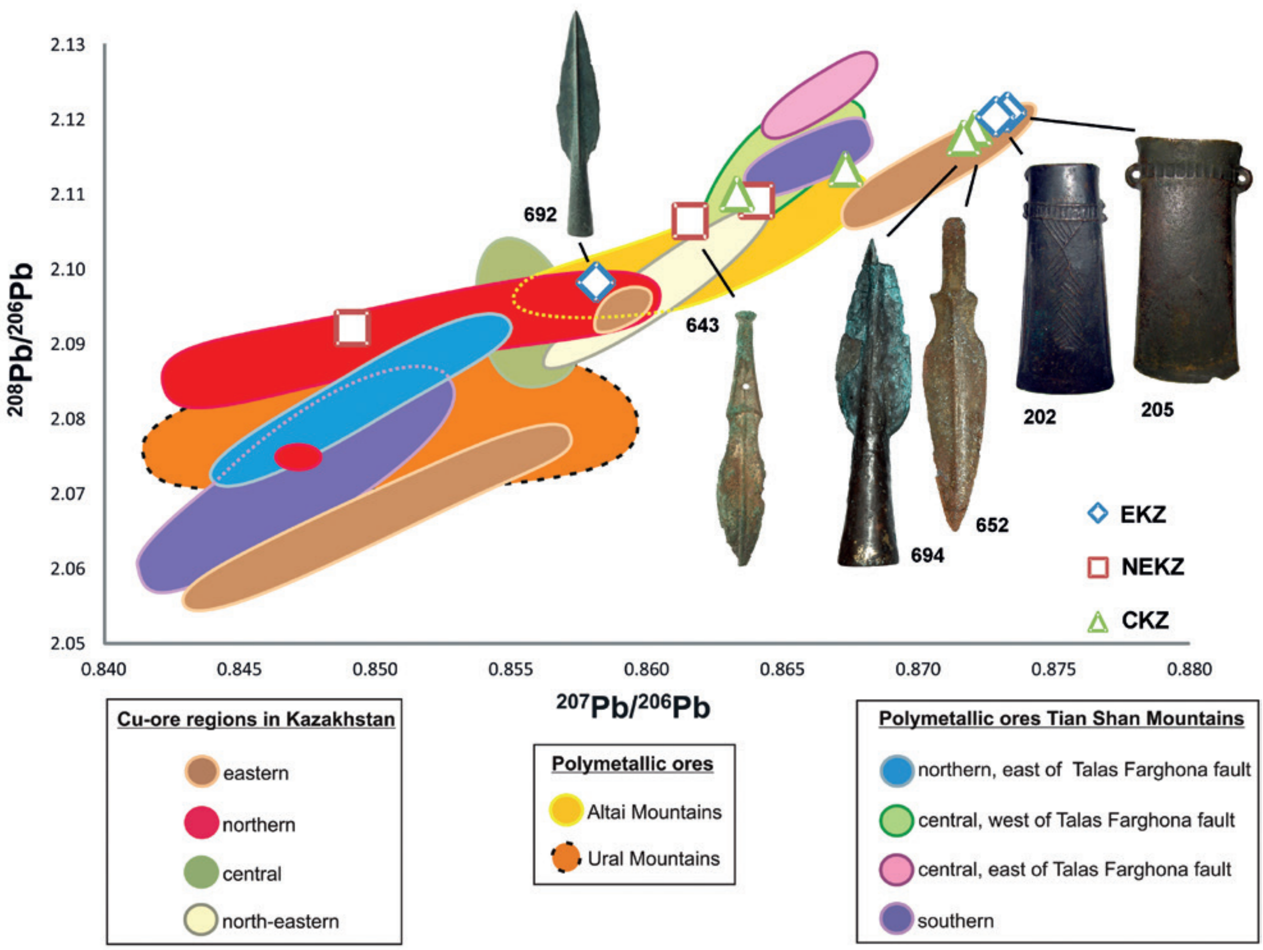
Figure 5. Nurataldy I, objects from metal deposition nearby grave 2; source: DBM/RUB, A. Gontscharov.

Sejma-Turbino types *sensu strictu* are spearheads with forked midrib, a series of early socketed axes, simple daggers with a flat blade and a broad quadrangular hilt plate as well as large knives with figural or a ring pommel (Sejma, Turbino, Rostovka) [8]. Such knives are regularly combined with Eurasian Types, while the depositions of Shajtanskoe Ozero 2 also display combinations with Samus`-Kizhirovo-types. Besides such depositions, classical Sejma-Turbino objects are only known as single findings.

Considering the Sejma-Turbino 'mode of deposition' (weapons plunged vertically into the soil), it has to be mentioned that the hoard of Nurataldy is the first case in which such a deposition is combined with Eurasian types (Figure 5) (Kukushkin and Loman, 2014, pp.584-587). Such a combination has an exceptional character and it cannot be explained without a practice-approach that includes the object-biography as well (see below).

It has been stressed that Sejma-Turbino and its tin bronzes are particularly a phenomenon of the forest-steppe and the Taiga ecological zones, while the Sintashta and Petrovka-cultural zones in the Steppe did not use tin bronzes in general nor these objects. This is especially clear when looking to the spectrum of Sintashta-Petrovka metals, but also to arsenical copper artefacts from the Petrovka-cemetery of Bestamak in North-Kazakhstan[9]. Whether the distribution of tin bronzes can be explained by migrations, a special prestigious goods network between pastoral groups in the forest-steppe and the hunters from the Taiga, or if iterant craftspeople are relevant, we cannot answer yet. However, it might be interesting to understand more about the practice of exchange over long distances. Chernykh (1992, pp.215-233) as also Chernikov (1949, p.73) previously deduced the origin of the tin bronze alloys especially in East Kazakhstan. Besides their special shape and colour, which made them highly prestigious and valued, it was perhaps their origin, which was memorised when handling them in depositional rituals. However, this might have been something that was true for all the shiny tin bronzes right at the beginning. Moreover, it is worth extending our angle of discussion to high tin bronzes also of younger chronological classification, as it might give an answer to the question of whether Sejma practices – the pro-

Figure 6. Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to high tin bronzes around 2000 BC ('Sejma-Turbino phenomenon'). EKZ = East Kazakhstan, NEKZ = Northeast Kazakhstan, CKZ: Central Kazakhstan, SKZ: South Kazakhstan, NKZ: North Kazakhstan (see also Fig. 7-8, 10, 18); source: DBM/RUB, M. Bode, Th. Stöllner.



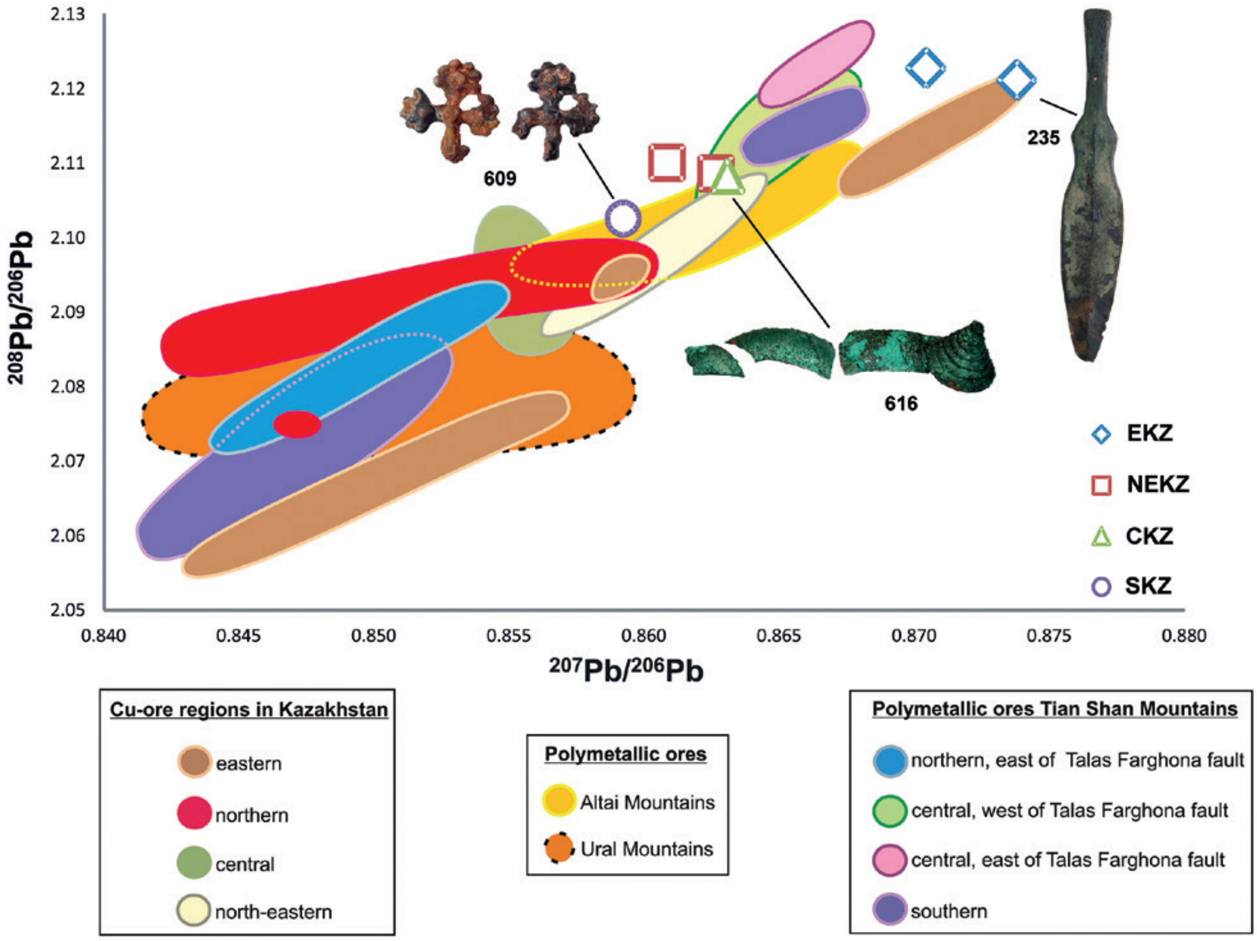


Figure 7. Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to high tin bronzes of the Andronovo phenomenon (1st half of the 2nd millennium BC); source: DBM/RUB, M. Bode, Th. Stöllner.

duction and the exchange of distinctively fine bronzes – were still known in the later Bronze Ages. So this study focuses not only on Sejma-Turbino bronzes, but on all the bronzes with high percentages of tin over 9 %[10]. In general, such alloys were characteristic for East Kazakhstan, but even other tin sources such those from Central Kazakhstan cannot be excluded (Figure 6). In general, it is likely that compositions with high tin levels have some probability of deriving from East Kazakhstan: something that can be checked by their trace elements, their LI ratios (Pb-isotope ratios) and their typology.

Let us first start with high tin bronzes and the Sejma-Turbino as a phenomenon of the earlier Bronze Age. It is particularly interesting to discuss especially objects with a distinctive typological setting that seem foreign according either to their typology and even more according to their LI ratios (Figure 6). Two Sejma-Turbino socketed axes from East Kazakhstan (KZ-202, 205) fit well to the regional field, while two Sejma-objects from Central Kazakhstan (Nurataldy I: KZ-652, 694) certainly originated also from East Kazakhstan. As the LI ratios derive most likely from the copper sources and as their tin values are high, it is most likely conclusion. An Elunino dagger from Michurino 1, grave 20 (KZ-643) (type 1A3 after Avanesova, 1991, pp.23-24) is interesting due to another aspect, and this is also true for a chisel found in the Shiderty 3-settlement) (KZ-306). Both can be assigned rather to foreign copper ores. In case of the dagger the Central Kazakhstan ores are the most possible origin while the copper from the chisel may derive from further west, either from North-Kazakhstan or even the South-Uralian ore fields. However, we interpret this result, we may accept their foreign origin anyway as an indication of the exchange of copper as such. On the other hand, the East Kazakhstan origin of some of the Nurataldy 1 objects might rather give reason to think about East Kazakhstan production and exchange of finished objects. This is an indication for the exchange of the object as such and its high valorisation because of its foreignness.

If we follow the question of high tin bronzes to younger periods, it is difficult to address the question for the Andronovo communities at the moment, as there are only very few examples available (Figure 7). A dagger from East Kazakhstan seems to be of regional origin:

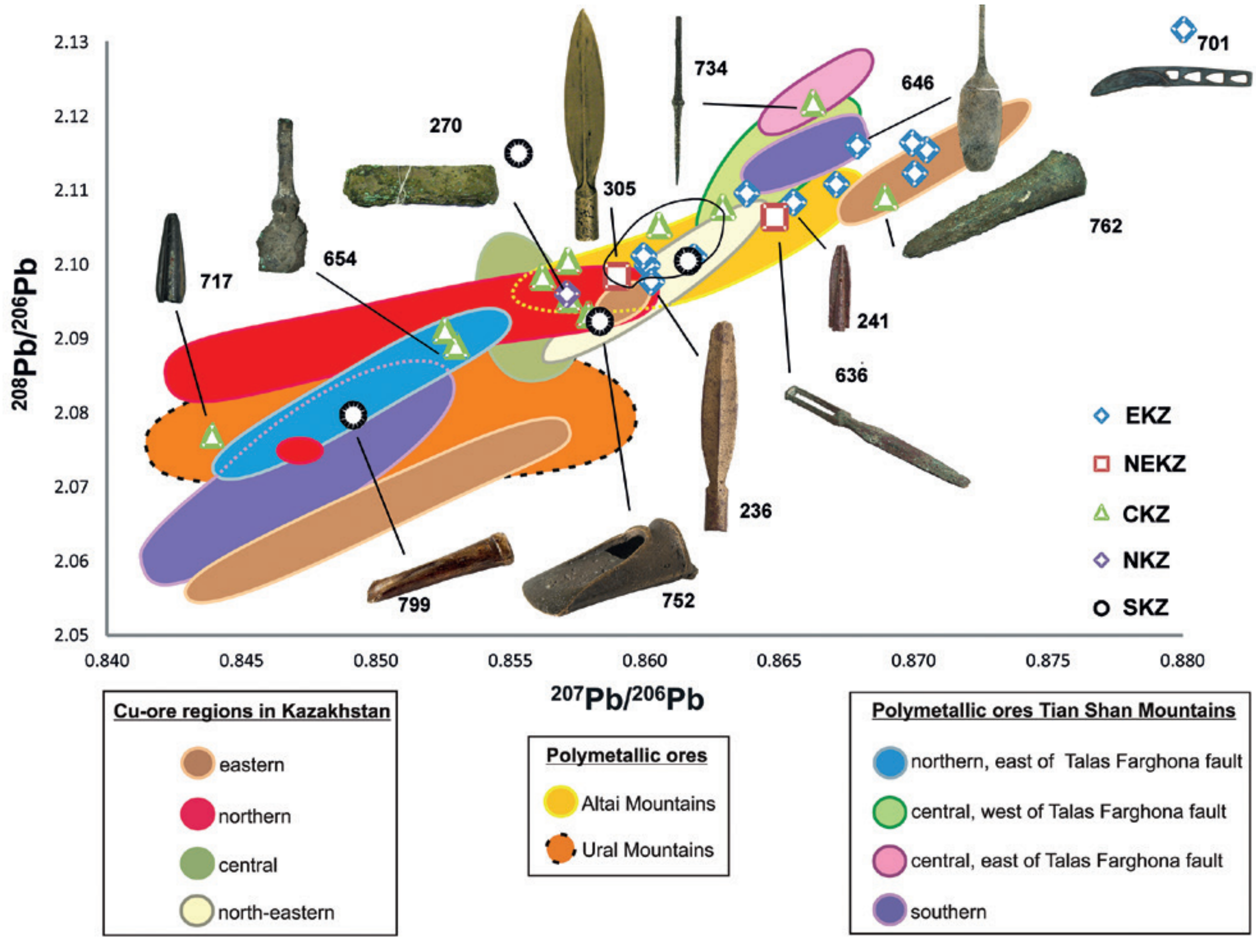


Figure 8. Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to high tin bronzes of the later Late Bronze Age (2nd half of the 2nd millennium BC); source: DBM/RUB, M. Bode, Th. Stöllner.

trace elements (e.g. zinc) and LI ratios coincide with the high tin content, which both are typical for this region. The same seems true for a bracelet of type IIIB2 after Avanesova (1991, p.69, fig. 52) that has been found in the grave group Kojschoky 2 at the grave circle 4. Typology and trace elements fit as do the LI ratios to the regional field of East Kazakstan. It can be argued differently for a cruciform pendent from the graveyard Baganaly from South Kazakhstan (Nr. 616, IID2 after Avanesova, 1991, pp.66-67): Although copper mineralisations are known from the Tien Shan Mountains, the trace elements as well as the LI ratios fit rather to Central Kazakhstan, from where either the object or at least the copper may have derived.

The picture of high tin bronzes is more complex when looking to the later 2nd millennium (Late Bronze Age) (Figure 8). There are several indications of foreignness when looking at metal composition and typology. Most striking is a Karasuk knife found as a single find near the village Bobrovka in East Kazakhstan (for the type see: Chlenova, 1972, pp.18-26, pp.40-44, pl. 1-4.). There are other examples of foreign bronzes found on sites like the large Bronze Age village of Maloe Krasnojarka near the Irtysh River. There is a socketed spearhead similar to the one discovered in Sharbakty near Pavlodar. Both spearheads are similar in metal composition (from Central Kazakhstan, KZ-236, 305) and typology[11]. Whether the dagger-shaped saw from Semijarka is foreign as well may be discussed, as the LI ratios points to deposits like the Tien Shan Mountains: the type is not common in East Kazakhstan, which may be another indication for its foreign origin. However, valued objects were exchanged even to the ore-rich East Kazakhstan. This directly finds its explanation in individual exchange and contacts. If looking to Central Kazakhstan, we find the same pattern for objects for a dagger fragment from Kent (KZ-654) and an arrowhead from grave construction 46 from Tasyrbaj (KZ-717), whose copper seems to come from the southern Ural mountains (as elevated arsenic contents also indicate). That underlines this assumption because the Kent dagger displays the so-called Cimmerian type of the later Late Bronze Age[12]. As it goes with the arrowhead, we can assume that the object came with a warrior and not as a trading item or a gift of high value. It is interesting to find a similarly foreign material with the arrowhead KZ-241 discovered in Maloe Krasnojarka: The copper would be better assigned to the Altai Mountains from which the carrier of the arrowhead might have come. All these Late Bronze Age items most likely suggest individuals who carried those pieces to their final depositing region within certain social interactions. Warriors, as before, still displayed for instance an important aspect within such individual contacts during the latter Late Bronze Age. But other contacts can also be discussed: A socketed chisel found in Kent (KZ-762) was likely fabricated from East Kazakhstan copper and tin ores (according to LIA and trace-elements) and came later to Kent – perhaps in a tool-kit of an itinerant craftsperson. The same would be true for a chisel from the same site (KZ-734), whose LI ratios excludes East Kazakhstan but indicates Tien Shan origin. The ore-deposits of the Tien Shan likely supplied copper for many of the South Kazakhstan Late Bronze Age hoards (e.g. KZ-799, socketed chisel from the Andreevskij/Kabanbaj hoard). It is also likely that metals were melted together with material from different origin. However, as it will be seen also with ingots (see below), metal was exchanged either in a pure, unalloyed form or as already alloyed bronze ready for casting (Nr. 270). This bronze ingot might have come via East Kazakhstan to the Chaglinka settlement (Orazbaev, 1970) – it is not completely clear if the copper fits more to the Altai or the western Rudnij Altai, as the LI ratios would also permit an origin of the copper from further west (Central Kazakhstan).

If looking in general to bronzes with high tin levels it is clear that copper of various origins has been exchanged and alloyed with tin that possibly derived from East Kazakhstan. Nevertheless, there are also other possible explanations: high tin alloys already casted into finished products might have re-melted and used[13]. It is also possible that the communities in East Kazakhstan had a preeminent role in producing objects of a distinct formal display (such as Sejma-Turbino bronzes, daggers). The same seems true also for prestigious jewellery and weapons from the classical Andronovo-period: Products were exchanged still, predominantly, while in the later parts of the Late Bronze Age the exchange of raw metal increases.

Nurataldy I, deposition grave 2 and 'Srubnaja' – daggers

One of the best contexts to understand the social dimension of an artefact assemblage are the hoarded items of Nurataldy I (Figure 5). The graveyard consisted of four slab cists, of which three were disturbed and one remained untouched. Two horse burials were discovered nearby. The complex, which remained unpublished so far, has been dated by the excavators V.G. Loman and I. Kukushkin to the early phases of the Andronovo/Alakul'-culture[14]. The burial of two horses can be understood as a reference to the wagon symbolism being thus characteristic for the Nurtaj group in Central Kazakhstan that was in tight chronological relation to the Petrovka group (Tkachev, 2002, p.147 [part 2]; Kukuškin, 2013). What stresses the chronological placement is the mode of deposition of the bronzes that were stuck into earth nearby the north-western corner of slab cist 2. This deposition mode is well-known from Sejma-Turbino sites of the forest steppe, for example from sites like Rostovka, Šajtanskoe Ozero II and Turbino[15]. Although the deposition mode clearly relates the Nurataldy I deposition to the Sejma-Turbino phenomenon, there are no Sejma-Turbino objects *sensu strictu* but rather objects that belong to the Eurasian component of the phenomenon (Chernykh and Kuz'minykh, 1989, tab. 17). Two spearheads and three daggers were plunged to the ground together with an arrowhead, three pieces of metal, a wrapped metal sheet, a cast piece and a broken metal fragment (Figure 5). The latter can surely be identified as material that could be recycled once and thus had some worth and meaning. The deposition however gives the impression of a conscious configuration of objects that might once have been connected with the buried, either as grave goods or as offerings of burial mourners[16]. So we may ask, could it be proven by typological and metal provenance arguments if the objects resemble personal furnishings (Figure 9)?

All the daggers (KZ-651-653) contained a high percentage of tin, but if looking more carefully to their LI ratios, it is clear that only two daggers, the rolled metal sheet and one spearhead did not come from Central Kazakhstan (KZ-651-652, 680, 694). One spearhead and one dagger are very close to each other (KZ-652, 694) and were made of East Kazakhstan copper, and therefore were most likely alloyed with tin from there. This fits also to elevated bismuth and lead contents that are known from East Kazakhstan ores and metals (Stöllner, et al., 2013, pp.388-389, fig. 5). On the other hand, there are objects whose LI ratios and trace elements would fit rather to LI-reference data from the 'Kent'-field of Central Kazakhstan (KZ-653, 682, 695, 731): dagger, spearhead, arrowhead and metal cast. The metal cast, maybe a small ingot, perhaps best resembles regional copper. It is a rather pure copper with very low impurities and contains nearly no tin, being thus unalloyed. It is different from the spearhead with the short socket: A low tin level and some antimony and lead do not really match to East, but

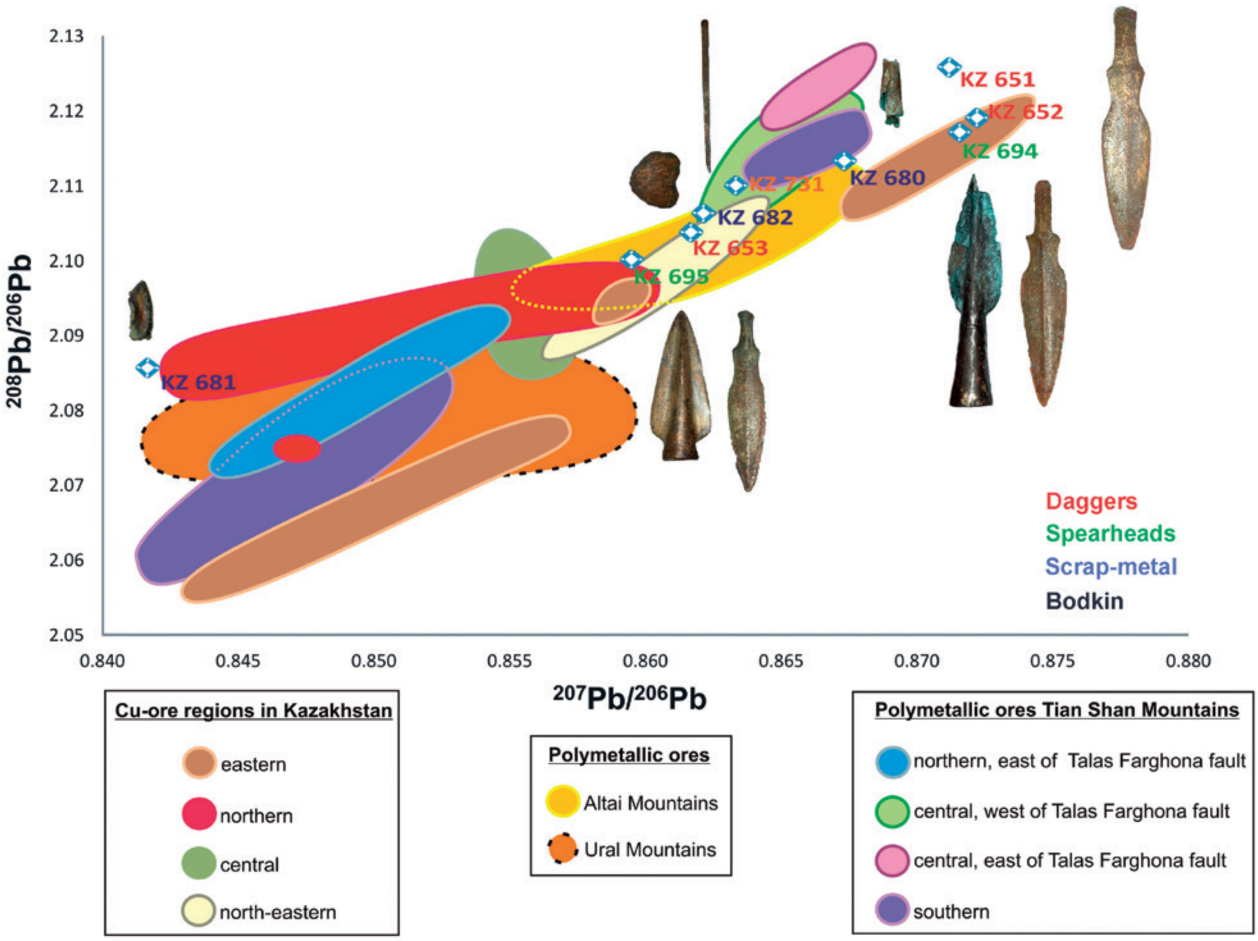


Figure 9. Pb-isotope ratio of ore samples from Nurataldy I, Sejma-tradition hoard; source: DBM/RUB, M. Bode, Th. Stöllner.

perhaps to Central Kazakhstan. Two other striking facts can be mentioned at the end: the arrowhead KZ-731 contains rather high lead contents, thus likely being alloyed. It is therefore impossible to make clear statements for the origin according to the LI ratios. The opposite is the case for the metal fragment KZ-681. The LI ratios indicates a composition that is completely outside of Central Kazakhstan. They rather would fit to the Uralian and North Kazakhstan deposits: silver, cobalt and especially arsenic are represented in higher values (for the ores esp. type 4: Tkačev, Zajkov and Juminov, 2013, pp.475-477).

The differentiation between a Central Kazakhstan and an East Kazakhstan group in the deposit can also be supported by typological considerations. If looking to the typological and chronological investigations of N. A. Avanesova (1991, pp.23-24, fig. 22), it becomes clear that the daggers belong to a larger typological field in which not all objects date at the same time[17]: If the East Kazakhstan dagger and spearhead were really synchronous is difficult to assess. The dagger 652 can be identified as a rather 'eastern' Andronovo-Feodorovka dagger type (Type 3/4 after Avenesova), while the spearhead belongs to the Sejma-Turbino phenomenon '*senso lato*'. On the other hand, the second 'outsider' (KZ-651) and the Central Kazakhstan tin bronze dagger KZ-653 show the rather early character of long side indentions (Central Kazakhstan Nurken group?). While other objects from the deposit cannot be dated in detail, there is even no clear connection of the spearhead with short socket to the Sejma-Turbino spearheads in general. Putting facts together, there is reason to understand the deposit as an asynchronous assemblage of different origin. If so, one could assume that this was the case not only for the objects, but also for the bearers. Is it possible that one dagger/spearhead assemblage (KZ-652, 694) came with a person from East Kazakhstan while another assemblage (KZ-653, 695, 731) might have fabricated with copper from Central Kazakhstan and perhaps tin from East Kazakhstan? However, the chronological and regional difference would stress a second personal aspect within the deposit.

The Nurataldy I deposit thus displays also social realities during the earlier 2nd millennium in the steppe and forest steppe zone of Central Asia: Metal objects and their origin were of importance within social interactions. It can only be assumed that the foreignness of materials (tin) and objects were still memorised when the Nura-

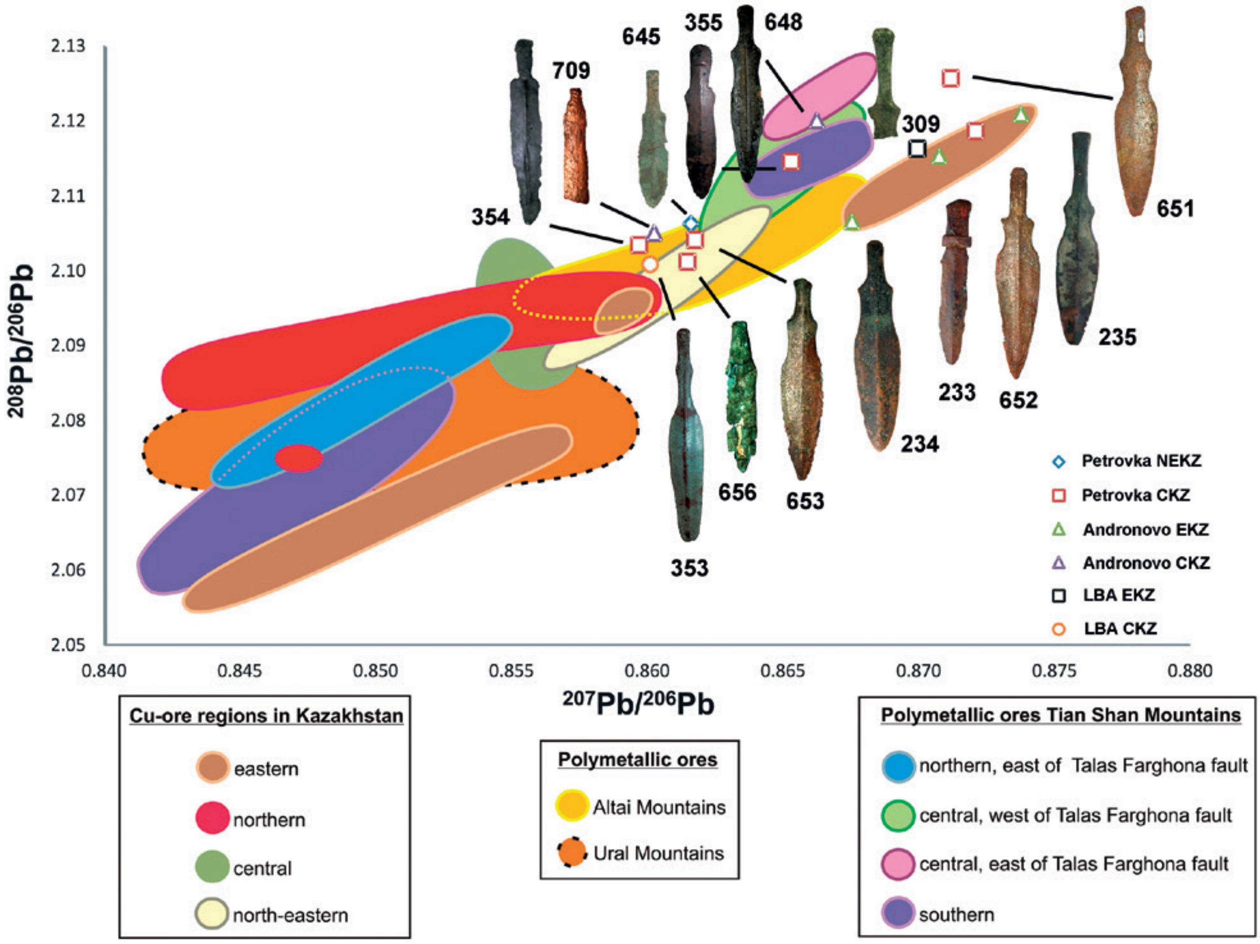


Figure 10. Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to 14 'Srubnaja'-daggers from the 1st half of the 2nd millennium BC; source: DBM/RUB, M. Bode, Th. Stöllner.

taldy I deposit was buried, most likely till the end of all ritual actions in the Nurataldy I graveyard. We certainly will never know if the objects were originally buried with persons within the slab cists, but if so, it would indicate a subsequent opening of graves and reburying of objects according to the older known Sejma-Turbino ritual[18]. If following these ideas we may certainly find traditions in memorising over a longer time period, thus bridging the centuries from the end of the 3rd millennium to the middle of the 2nd millennium. Therefore, it would not be a surprise to find concepts that can be found within the Sejma phenomenon and the fully developed periods of the Andronovo communities. Therefore, it may be informative to dagger groups of the Andronovo culture (generally known as 'Srubnaja daggers') in more detail.

This group is widely distributed in Eurasia[19] and can be characterised by the indentation beneath the guard. E.N. Chernykh and N.A. Avanesova have tried to classify this very broad group by using elements of the mounting of the handle[20]. Avanesova's typology had been criticised by E.N. Kuz'mina (1966, pp.41-43) because of its predominant focus on a chronological interpretation. According to the relationship that the guard has to the indentation beneath and the length of the blade, we can assign most of the daggers to the type-group A2/3 (235, 645, 651-653; basically Petrovka and earlier Andronovo, e.g. the Nurken-group) and some to perhaps later type-group A4/5 (234, 648) (basically Andronovo-Feodorovka). Some of the daggers from Central Kazakhstan even resemble earlier types of the Srubnaya-type-group or cannot be assigned to Avenasova's specific types (A1: KZ-656; unspecific: KZ-354-355): they belong also to earlier parts of the Petrovka-time period at the beginning of the 2nd millennium BC. Although Avanesova's typology cannot be used for a finer and strict cultural and chronological assignment, it may help to link connections between objects distributed on a vast area. If we look at the geochemical characteristics and also the amount of tin-alloyed objects, it is possible to separate two larger groups within our 14 daggers: There is an East-Kazakhstan-group whose tin contents are basically higher than those from the Central Kazakhstan group (Figure 10). What is even more striking is the indication of foreign objects in Central Kazakhstan that might

	shaft-hole axe	socketed axe	socketed adze with open socket	socketed chisel	socketed gouge	flat chisel	open worked spearhead	socketed spearheard	winged sickle	reaping knife	knife	dagger	dagger with column shaped handle	mirror	back ledged flat axe	bracelet	ring	razor knife	single point pick/hammer	socketed hammer	phalera	strap knobs	bar toggle	metal vessel	awl	burst metal
Semirečje																										
Karakol 1				■											■											
Sukuluk 1	■	■		■	■					■		■		■	■											
Sukuluk 2									■																	
Issyk-Kul`	■						■		■																	
Šamši	■			■	■					■	■	■		■			■	■		■	■				■	■
Bričmulla														■							■					
Sadovoe		■		■	■						■			■	■					■						
Kamenskoe Plato					■										■											
Alekseevskij	■				■					■					■											
Turksib	■			■						■	■	■														
Andreevskij (Kabanbaj)		■	■	■	■	■											■				■	■		■		
East Kazakhstan																										
Predgornoe							■	■	■																	
Palatzy			■										■			■			■							
Predgornoe/grave									■																	
Burabaj/Kurčum											■	?													■	
Kurčumskij Klad											■								?				■		■	■

Figure 11. Table of Semirechye and East-Kazakhstan hoards according their furnishing; source: DBM/RUB, A. Gontscharov.

have come from Rudnij Altai, and Kalba-ore fields in the East (651, 652, 309) from the earlier horizons of the Andronovo-groups (Petrovka, Nurken-group, such as the daggers from the Nurataldy hoard, see above)[21]. We also can regard other outsiders from Central Kazakhstan such as the daggers KZ-648 and KZ-355 that generally would better fit to the Tien Shan Mountains (according to the LIA). One might assume that daggers were exchanged in the framework of social practices as a gift and during warlike actions. The small dagger KZ-645 indicates perhaps the opposite: The piece was found in grave 8 of Michurino (Northeast Kazakhstan) and might have been fabricated from East Kazakhstan tin ore either by co-smelting or alloying. East Kazakhstan mixed with an ore from the Uspensko-Karkalinsky ore field (Figures 4 and 10). A meaningful interpretation could be in this case the transport of the tin and the copper from other regions to the eastern shores of the Irtysh River.

East and South Kazakhstan (Semirechye) hoards

In the Central Asia metallurgical area, hoards are largely absent. This stands in opposition to East Europe where 2/3 of all metals have been deposited in hoards (Agapov, 1990, p.9; Černych, 2013, p.197, fig. 12). There is a series of hoards that we know from West Siberia and East Kazakhstan (Balandino, Omski klad, Rostovskinskij klad, Kystaul-Kurchum, Palatzy and Predgornoe), as well as a larger series of at least 11 hoards from South Kazakhstan and the Semirechye (Karakol 1, Karakol 2, Sukuluk 1, Sukuluk 2, Issyk-Kul`, Shamshi, Brichmulla, Sadovoe, Kamenskoe Plato, Alekseevskij and Turksib) [22].

The hoards from East Kazakhstan are not so different from those of Semirechye (Figure 11). The variation of types is less than in the south, but in both regions the hoards appears to be significant in the combination. This is obvious when comparing the Predgornoe hoard (Figure 12: 2) with the inventory of a neighbouring cist grave consisting of five winged sickles and a spearhead (Arslanova, 1974). Sickles, as we know them from the Predgornoe hoard, have been found both as single finds and in settlements. It seems likely that the hoard deposition and the grave good deposition once resembled similar ritual ideas of the persons offering the items. Another aspect is displayed by the hoard from Kystaul-Kurchum (Figure 12: 3): It resembles the character of a metal collection, similar to 'burst' metal hoards ('Brucherzhorte') from Central Europe (in general: Hansen, 1994). It is even interesting to note a foreign origin by means of their LI composition (Figure 13), particularly for a toggle and arrow-head/dagger (KZ-183, 184) and the casting residues (KZ-180, 185). Another hoard of this kind was discovered recently in Burabaj consisting of three knives, eight awls and chisels pointing to some relation to a crafts tool-kit[23] (Figure 11).

East Kazakhstan and Semirechye hoards obviously resemble two regional clusters having similar ritual and

Figure 12: East Kazakhstan LBA-hoards: Palatzy (1), Predgornoe (2), Kystaul-Kurchum (3); photos/source: DBM/RUB, M. Schicht, Th. Stöllner.

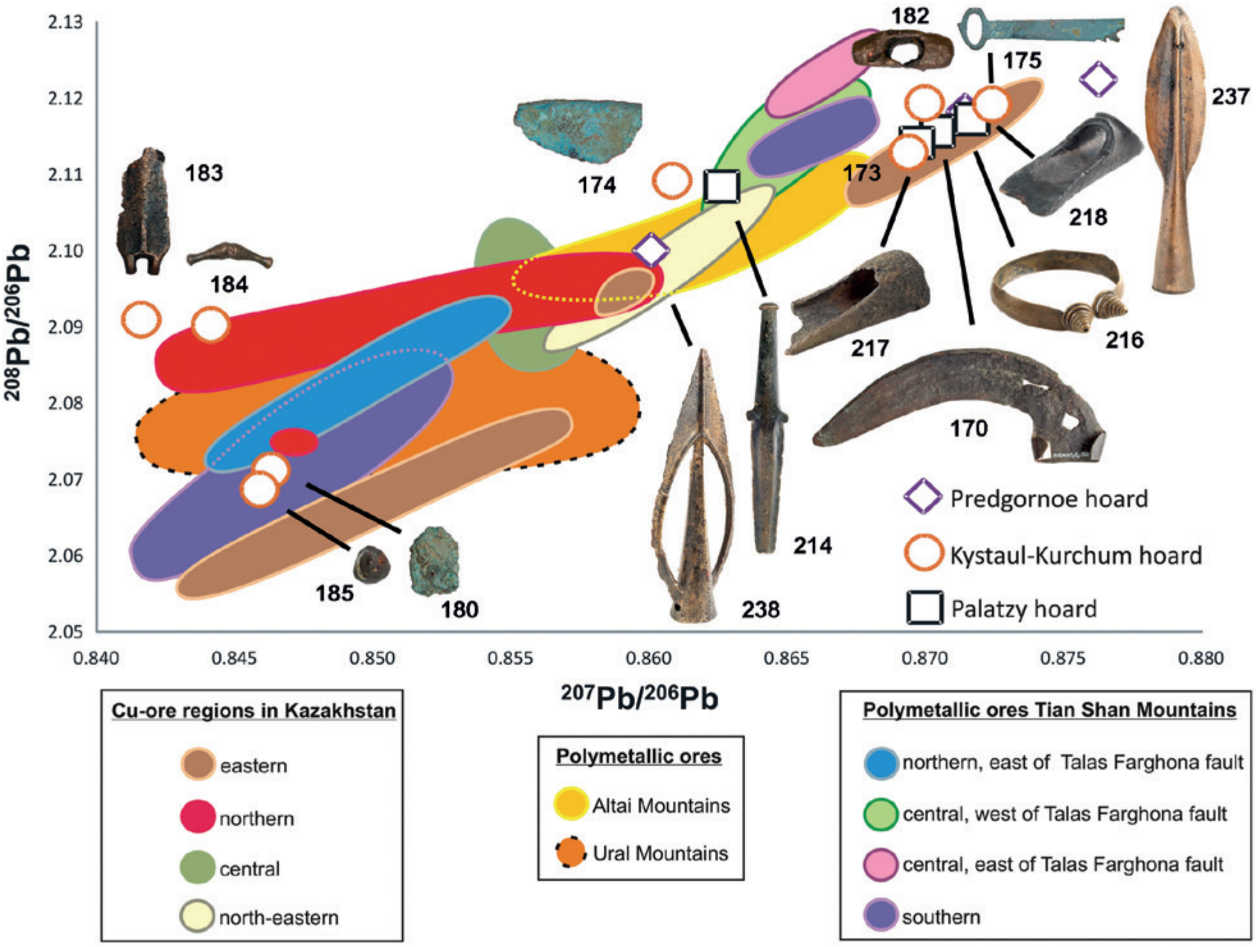


Figure 13. Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to the LBA-East Kazakhstan hoards; source: DBM/RUB, M. Bode, Th. Stöllner.

ideological backgrounds. If we look at their object compilation, we notice a certain range of objects that cannot be found in graves but must mirror common ritual practices during communal actions that brought together those assemblages. There is no doubt that these objects are part of deliberate assemblages or 'furnishings'.

Therefore, we may ask whether these assemblages reflect a change in social practice during the 2nd millennium, in a time when metal circulation had increased and metal production reached an even higher level than before. Settlements like Kent can make this unmistakably clear if we consider the far-distant exchange of goods and the vast extent of metal working found there (Varfolomeev, 2011) (for LIA of metals, see Figure 4). Kent is one of many sites where metal crafts had an important position within the daily practice and the economic strategy. The question we could raise here is if there was a higher commoditisation in dealing with metals: Did metal consumption, even in its ritual and social sphere, mirror a change in this respect?

To follow this question, we can compare three hoards, which we also have investigated, although not all of them have been analysed in all necessary detail concerning their metal composition (Figures 13 and 14)[24]. Some older analytical data are available but do not meet the requirements of modern analytical standards. These analyses only allow a very rough estimate of the metal compositions of the Semirechye and Central Asian hoards (Kuz'mina 1966, pp.102-109) [25].

The East Kazakhstan Predgornoe and Palatzy hoards (Figure 12) still incorporate high tin bronzes such as a sickle, adzes with open sockets, spearheads and a bracelet that plot within the LI ratios of East Kazakh ore field. They seem of local origin, but there are foreign objects also: one is the open worked slotted spearhead that is an international type used in the 2nd half of the 2nd millennium but was in use until the earliest phases of the Early Iron Age[26]. When considering the poor trace-elements in general and the zinc and lead-contents in particular, it is clear that similar tools from the Kabanbaj hoard, but also some objects from the Predgornoe with low trace-element level, resemble a field that is not typical for East Kazakhstan bronzes (see also Stöllner, et al., 2013, pp.388-389) (Figures 13 and 14) [27]. This applies also for

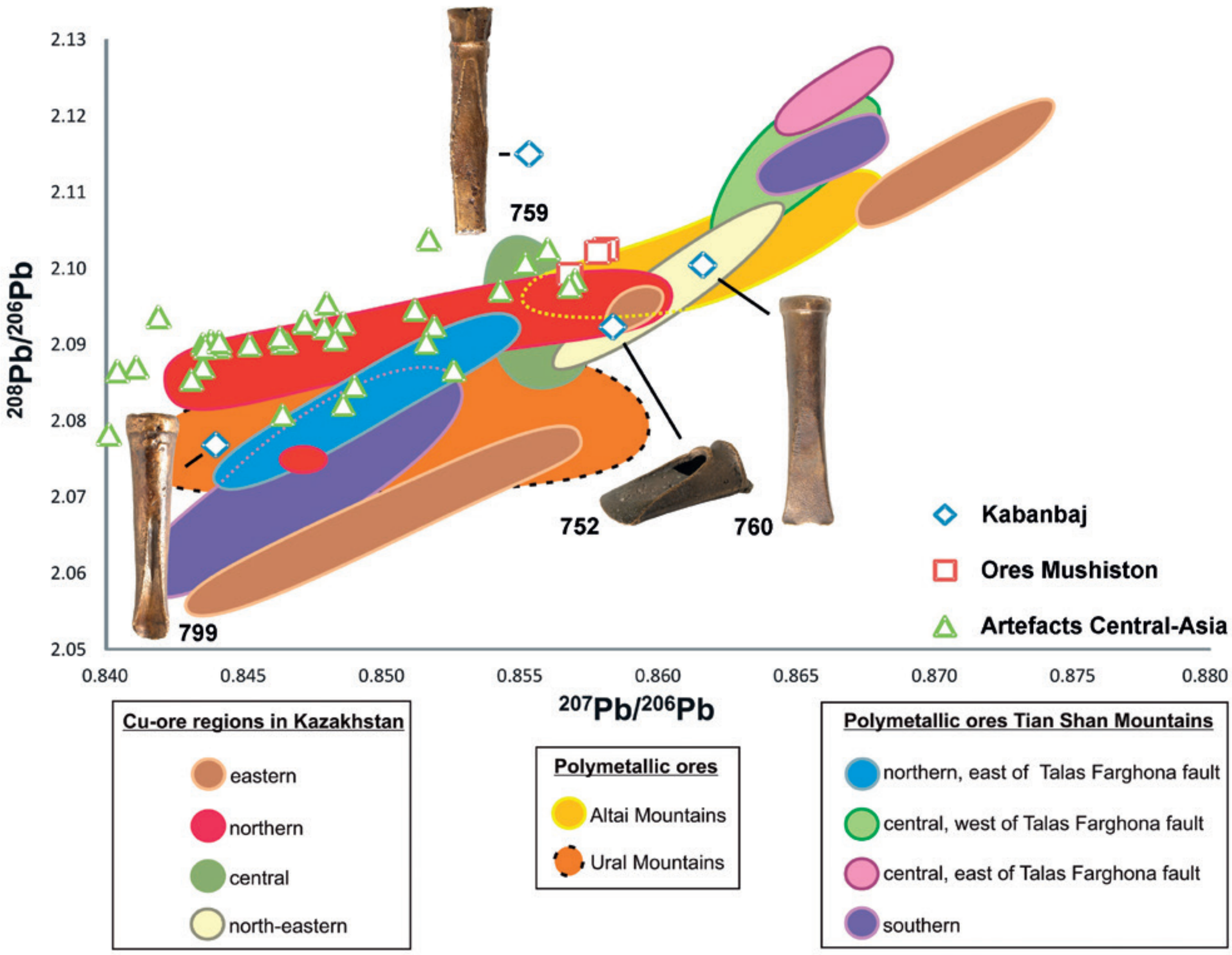


Figure 14. Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to Mushiston ores and Middle Asian metals; source: DBM/RUB, M. Bode, Th. Stöllner; data from Middle Asian metals by courtesy of J. Lutz/E. Pernicka.

a rather low tin alloy, thus we would suggest the spearhead was made from chalcopyrite ores from Central Kazakhstan. If this can also be indicated for the second spearhead (KZ-237) from the Predgornoe hoard is rather unsure. Although the copper is as pure as the one used for the slotted spearhead (KZ-238) from Kabanbaj, the metal should derive from a rather geologically old ore deposit, which would not be that typical for the geologic ages of Central Kazakhstan ore deposits. It is interesting to note that even other metal objects from the Predgornoe and the Palatzy hoards, such as the adzes with open sockets and the sickle, display types that were distributed on a broader regional field between South and East Kazakhstan to the Minussinsk basin (Figure 12: 1-2). This is also true for the sickles of which nearly 50 examples are known today[28]. On the other hand, the adzes have a broader regional variation that also includes examples from Siberia and the southern Ural[29]. In general, there are many reasons to argue for a more intensive relationship with the Minussinsk basin, where the ore-production started during the 2nd half of the 2nd millennium on a large scale (Parzinger, 2003). It would not be surprising if the exchange of copper and tin could have been the background of individual contacts that is mirrored by the Karasuk knives (e.g. KZ-701) in East Kazakhstan, but especially also by the so-called Karasuk dagger from the Palatzy hoard (KZ-214) [30].

What becomes clear by this discussion of typology and metal composition is that the East Kazakhstan hoards still display some kind of singularisation, by, both, their furnishing and the foreignness of some of the objects (Karasuk dagger; slotted open worked spearhead). Despite the fact that such hoards show some emphasis on their furnishing, there are also metal hoards such as the Kurchum-hoard that bear aspects of wealth accumulation and the value of metal. According to the elemental composition (see Table 1, Figure 15), a regional origin from East Kazakhstan, seems not improbable for many objects, although there might have been still involvement of foreign copper such as from the southern Tien-Shan Mountains. This points to the transport and exchange of ingots at the same time.

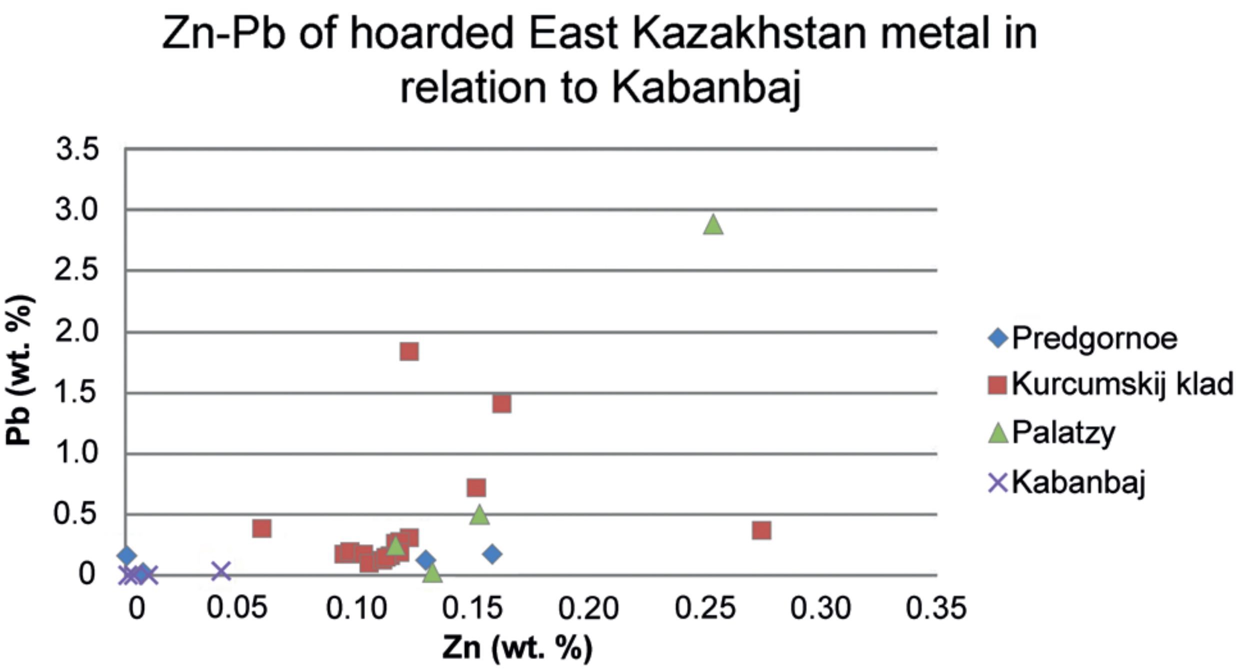


Figure 15. Zn-/Pb-levels of LBA-hoards from the Semirechye and East Kazakhstan, source: DBM/RUB, M. Bode, A. Gontscharov.

Let us have a look to the hoard discovered in 1983 near the Kabanbaj village (Alakolskij rajon) in the Semirechye region. The hoard consists of about 10 to 15 objects (Figures 11 and 16, Karabaspakova, 2011; see also Stöllner and Samashev, 2013, catalogue no. 181-190) of which only four could be analysed for their chemical and isotopic composition. The assemblage obviously has a connection to a woodworking crafts sphere represented by tools such as a socked chisel, three gouges and two adzes as well as a heavy and two lighter axes. Most of the tools are widespread Eurasian types of the so-called 'cultures of the ceramic with cordon applications' (valikovaja keramika), such as the socketed chisel[31], the adze with open sockets (see above), the socketed gouges[32] or the large socketed shaft-hole axe. The later axe is a very common later Andronovo Bronze Age type that spread in southern parts of Central Asia to the Xinjiang Province of China (Kuz'mina, 2001, p.7, fig. 7; 2004). The Kabanbaj hoard can be compared with many aspects to other Central Asian hoards such as the Shamshi-hoard (Kuz'mina, 2001, p.5, fig. 4) (Figure 17). Therefore, it is not surprising that also the possible provenance of the metals fit rather to a Middle Asian isotope field (Figure 14) but reveal also high tin levels what would indicate alloying with tin. As there is no clear overlap with Mushiston ores, one of the high altitude tin-copper mines that was also exploited already by Andronovo communities (Garner, 2014), alloying with East Kazakhstan tin is likely. At least one object (Nr. 760) was made from sulphides from Central Kazakhstan, a region, in which East Kazakhstan objects and most likely, also tin from the Kalba Narym Mountains was used to a large extent (recently Stöllner, et al., 2011) [33].

But it certainly needs further discussion to understand the southern contribution to this metal exchange, as the tin and copper/tin deposits of the Tien Shan and Fergana valley were in reachable distance, especially regarding high mountain-transhumance activities (for the ore deposits see also Rusakov and Korolev, 1935). If looking to the Semirechye hoards and their composition in general we see similarities in which materialised social spheres have been combined. Tools and prestigious axes as well as daggers and knives together with ornamental discs (e.g. phalerae), can be observed quite often (Figure 11). It is evident that the social concept of singularisation and valuation of foreignness of objects were kept in these assemblages likely also combined with the vision and knowledge of a foreign origin of the material used (for instance KZ-760 see above).

Although our insight is limited at the moment, we may assume that hoarding practices during the late 2nd millennium did resemble many of the concepts that we previously have found in the older periods. Hoards, especially those with furnishing structure, differed only by their social and ritual practice but in general followed the rules of object valuation in terms of foreignness. Nevertheless, as we also see with Kabanbaj; there must also have been trading and exchange of tin and copper at another level that is not displayed by those findings. Therefore, let us have a look finally to finds like ingots, semi-finished products and scrap metals from settlements (Figure 18). The geochemical pattern of this ma-

Figure 16: The Kabanbaj/Andreevka hoard; photo: DBM/RUB, M. Schicht, drawings: Karabaspakova, 2011.

terial basically should display the origins better than socially valuable items. The data indicate regional origins as well as foreign origin especially of semi-finished products and ingots. This proves metal trade of scrap/raw metal from different origins to Central Kazakhstan. A series of analyses is dominated by material from the large Kent settlement. These fit to the inter-regional exchange pattern that can also be observed with the help of the ceramic assemblage (e.g. Varfolomeev, 2011; 2013). Ingot trade and exchange can also be seen for other regions, such as East and Northeast Kazakhstan during that period (2nd half of 2nd millennium). It is interesting to note that casting and forging techniques widely overlapped when comparing especially the areas of Semi-

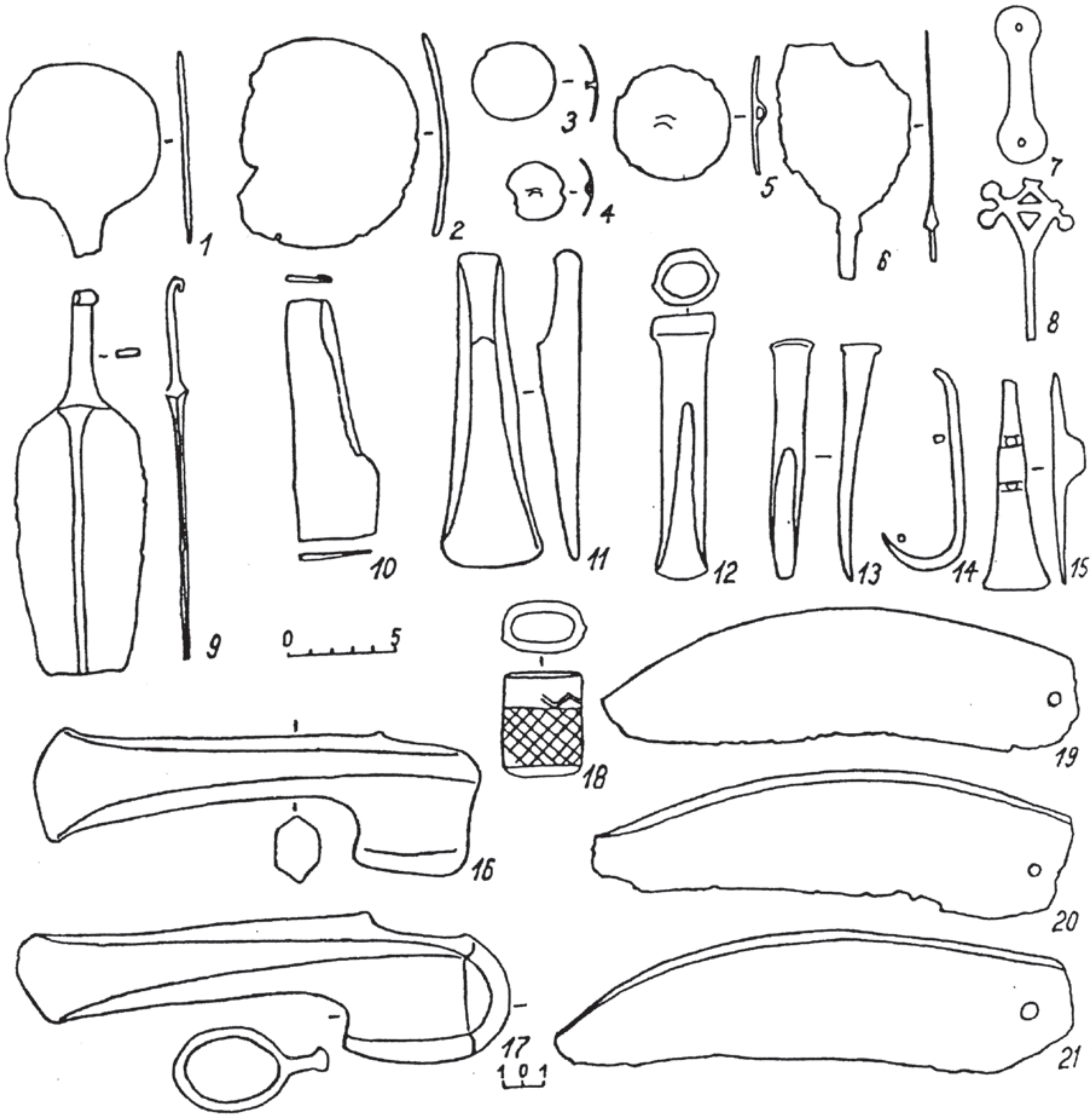


Figure 17: The Shamshi hoard (Kirgistan), photos: Kuz'mina, 2001, p.5, fig. 4.

rechye, East, North and Central Kazakhstan (Agapov, Degtjareva and Kuz'minych, 2013, pp.464-465, fig. 8). It is clear that also technical knowledge was transferred in the frame of mobility and exchange processes. Agapov, Degtjareva and Kuz'minych (2013, p.465) mentioned the technique of diffusion annealing as a highly advanced technique in handling tin bronzes within the Late Bronze Age communities of these regions, a practice that is especially common in East Kazakhstan.

It is interesting to learn that this exchange followed the older exchange patterns. It therefore may be allowable to ask if the inclusion of foreignness of objects that is displayed especially in the East Kazakh hoards reflect also commercial trade, especially in the Late Bronze Age. What also finally appears is the impression that all the metal finds within graves and hoards provide the picture of an increasing commoditisation of goods during the Bronze Age in Central Asia. Nevertheless, there were aspects of singularised objects in archaeological contexts, and it seems that the objects were not seen purely as commodities.

Conclusions

Trade as social practice - objects as items of social practice – insights into Central Asian metal exchange

Concepts of 'foreignness' and social valuation of objects seem to have influenced many assemblages that we know from hoards and graves. Many of the metals deposited evidently were given a special history and valuation.

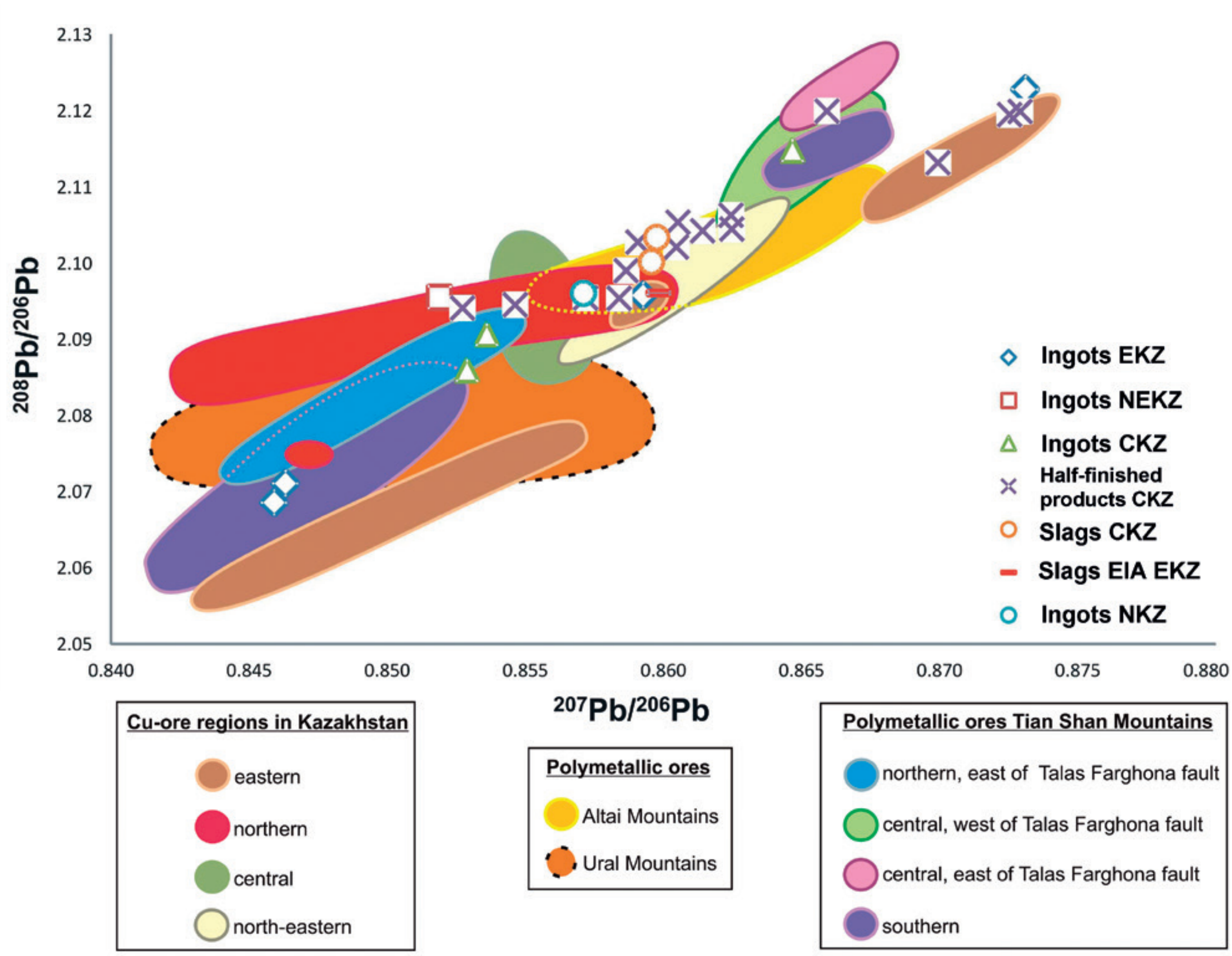


Figure 18: Pb-isotope ratios of ore samples from different Kazakhstan regions in comparison to scrap metal, ingots and half-finished products as well as slags; source: DBM/RUB, M. Bode, Th. Stöllner.

What the Sejma-Turbino phenomenon demonstrates in an impressing manner is also found as a pattern in wider contexts, even in hoarding practices of the Late Bronze Age. It is striking that especially during the older phases of the Bronze Age this motive probably was the dominant one. In addition, it possibly reached back even to older layers of time of the 3rd and late 4th millennium BC when regarding modes of mobility and pastoralism (e.g. Frachetti, 2012).

Within regional fields (e.g. East/Central Kazakhstan) we could prove the exchange of metals, but it is much harder to find evidence of this commodity exchange on an inter-regional scale especially during the earlier parts of the 2nd millennium BC (e.g. the Petrovka/Andronovo cultural communities). The daggers with hilt plate (so-called Srubnaja-daggers) are a good example: In the Nurataldy hoard a foreign dagger was probably combined with a foreign spearhead. Such equipment thus at one time might have been elements of exchange and gift practice between individuals and groups. Nevertheless, what cannot easily be seen is the actual exchange of metal as a trade commodity. This certainly has to do with the elusiveness of our sources, as settlements and their metals are not investigated on any sizable scale – though many Central Kazakhstan settlements like Atasu were already occupied during this period.

During the latter parts of the Bronze Age, the commoditisation level can be deduced with more security, as ingots, scrap-metals, and semi-finished products from settlements indicate a level of inter-regional trading (Figure 18). If considering the lead-isotope data especially from ingots and semi-finished products found in Kent and various other parts of Kazakhstan, it points to the long-distance exchange of metals and products. Still the foreignness of the material could have been an important aspect of the material, but certainly it was only part of the story inherited in finished objects. When comparing foreign ingots in East or Central Kazakhstan with the pattern of object exchange between different regions than we may conclude a similar pattern. This would mean that social practices of object exchange could be related to the metal exchange to certain extent.

The large settlements in Central Kazakhstan especially appear to have been nodes within such commodity trade systems. It is interesting that the long-distance exchange pattern had also a social dimension while single, high-valued items were handled and exchanged further on: We still find them in hoards and graves. They might reflect a special gift exchange between the participants that was somehow related to commodity exchanges (cattle, raw materials also). It seems to us, in numerous cases, that the exchange of goods on a small scale remained the main commercial practice also in the Late Bronze Age, and this despite the growth of the population and a larger number of participating communities increased the number of people involved[34].

This reminds us to the various levels of exchange that had been described for the Western Melanesian societies in the frame of the *kula*-ring (in general the classic work of Malinowski, 1922; Mauss, 1925/1999). Within the frame of the *kula* personal items, so-called *kitomu*, became transformed into exchange items such as *soulawa* (a jewellery chain) and *mwali* (a bracelet) whose importance and 'fame' increased continuously as long as the item went from one gift-giver to the next. The object became even more valuable and personified as it handed over the fame and prestige of the original and subsequent possessors (e.g. Godelier, 1999, p.133). It seems therefore such a value 'charging' for items like shiny spearheads, axes and daggers occurred: A group of such 'charging' perhaps can be seen in the Sejma-Turbino items in particular.

However, the exchange of socially prestigious items is only one element of exchange that was observed by Malinowski: besides the prestige giving, *kula* exchange, there was also the regular barter trade called *gimwali* (Malinowski, 1922, p.96, pp.189-191, pp.362-364) – *kitomu* also could be used for this regular exchange. In other words, personal belongings can serve as gifts in various directions and also used in other forms of exchange.

When Kopytoff (1988, p.87) distinguished that '*in small uncommercialized societies, the drive to commoditization was usually contained by the inadequacies of the technology of exchange, notably, the absence of a well-developed monetary system. This left room for a cultural categorization of the exchange value of things*' – we may be allowed to put a question mark on it. Our Central Asian examples indicate the existence of both at the same time: commoditisation as well as the singularisation. As also the modern revision of M. Mauss' concept of gift exchange has shown (e.g. Godelier, 1999; recently also Windler, 2016): the social display of gifts is only one side of the coin within a much more complex prehistoric reality.

Notes

1 Such examples are known for axes from the New Guinean ethnographic record where such special stones inherited a bundle of memories that were kept alive by using them (general Pétrequin and Pétrequin, 1993; e.g. Pétrequin and Pétrequin, 2006, pp.249-257).

2 It is clear that in reality these valorisations are fluid and we might have to decide in individual cases what is most likely.

3 Gontscharov, 2019. Within this thesis all, the recent geochemical data will be published in a comprehensive way. All the samples are ordered numerically and following the acronym "KZ" for Kazakhstan. Within this article we only provide data from the case-studies chosen for our argumentation. The location of the sites of the metals discussed in the article please use Figure 1. Besides all the Museum's and collection colleagues from Kazakhstan whom we want to thank for their fruitful collaboration, we especially want to thank Dr. Z. Samashev (Astana), Dr. V. Loman and Dr. V. Varfolomeev (Karaganda), Dr. V. Merz (Pavlodar) and G.A. Kusch (Ust-Kamenogorsk).

4 In general, we discuss metal provenance by a combination of data according to methods already well established: Pernicka, 1995; Hauptmann, 2007; Klein, et al., 2009 based on the geochronological model of Pb-isotope ages established by Stacey and Kramers, 1975. Thanks to Prof. Dr. Sabine Klein, Dr. Michael Bode, Dr. A. Gerdes and Prof. Dr. Michael Prange for their help and kind assistance.

5 The extensive sampling was possible to the wonderful cooperation with our colleagues from Karaganda: We have thankful in mind Dr. Valerij Loman, the head of the University Museum, but also Dr. Igor Kukushkin, Dr. Viktor Varfolomeev and Dr. Valentin Evdokimov.

6 There is a wide range of literature of which we only cite some: Chernykh and Kuz'minykh, 1989; Parzinger, 1997; Schwarzberg, 2009; Serikov, et al., 2009; recently also as a historical meta-narrative: Černych, 2013, pp.198-191, fig. 2, 4.

7 The new findings from Shajtanskoe Ozero help also to clarify chronological aspects: ^{14}C-datings from wood indicate – however, one interprets old-wood-effects taken from samples out of the axe-sockets – that Sejma-Turbino artefacts (*senso strictu*) might have been used over a long time span: oral information by R. Krause, Frankfurt.

8 It can be mentioned that daggers with figural pommels are common during the Eurasian Bronze Age and it is not always clear if they can be connected with the Sejma-Turbino phenomena culturally and temporally: A.D. Degtjareva (1985) argues that the hoard of Karakol (Vinnik and Kuz`mina, 1981) and his five daggers can be assigned to the Sejma phenomenon, and this is true also for the sword that has no analogies but his iconography at the pommel follows the same line as the daggers.

9 Metals have been analysed by the courtesy of A. Logvin from Kostanaj: A. Gontscharov discussed these results in the frame of his PhD-thesis.

10 We deliberately did fix the lower limit of high-tin alloys with 9 % according the general distribution of tin levels in Kazakhstan (Stöllner, et al., 2013, pp.386-387).

11 One even could discuss whether both objects originated from a source in East Kazakhstan: But even then it would be likely that both spearheads originally came from similar source and were perhaps manufactured by persons who felt constrained to one crafts tradition.

12 For the type look: Type 1V after Avanesova, 1991, p.25, fig. 22: 25; Grishin, 1971, p.15; Chernykh, 1970, p.63.

13 Spindler (1971) has supposed this for the introduction of tin alloys in the European Bronze Age.

14 We are grateful to V.G. Loman, who enabled the sampling and provided us with additional information of the site: see also Kukushkin and Loman (2014).

15 Matjuščevko and Sinicina, 1988, fig. 51, 53; Serikov, et al., 2009, pp.69-70; Bader, 1964.

16 This may not necessarily mean the objects belonged to the buried individual in life.

17 Typological differentiation can be made – according to Avenesova – with the indenting side-parts below the daggers handle bar: Type 3/4 shows rather short, type 4/5 rather long indentions, according to Avenesova (1991) a late attribute. There had been criticism on Avenesova's chronological implications especially by D.F. Vinnik and E.E. Kuz'mina (1981): see the PhD of A. Gontscharov (Gontscharov, 2019).

18 The interpretation of the Nurataldy deposit depends basically on the chronological concept being applied: Following Kukushkin and Loman (2014, p.586) arguing for an early Andronovo Nurtaj-dating while Avanesova (1991) related the artefacts rather to comparisons of Andronovo-Feodorovka-complexes.

19 Krivcova-Grakova, 1955, p.140; Chernykh, 1976, pp.118-119, fig. 50; Grishin, 1971, p.15; Kuz'mina, 1966, pp.41-43.

20 Chernykh, 1970, pp.62-63, p.82, fig. 57 and 58; Avanesova, 1991, pp.23-24, fig. 22; see also Gontscharov, forthcoming for a detailed discussion.

21 This especially applies to the higher lead contents in combination especially for the daggers 651-652.

22 Semirečje has produced 11 secure hoards Degtjareva (1985, p.21) mentioned 12 hoards, but it has to be said that the hoard Karakol 2 may belong to an older chronological group, perhaps to the Sejma-period (Vinnik and Kuz'mina, 1981). Further assemblages have been discovered during the construction of the Ču-channel during the 1930's; their composition reminds us to hoards: Kuz'mina, 1966, pp.101-102.

23 Thanks to G.A. Kush who supported us with kind information about these and other recently discovered finds in Eastern Kazakhstan.

24 Not all the deposits could be investigated in terms of their LIA-composition and also not conclusively in regard of their chemical and trace-element composition: We are deeply grateful to G.A. Kush (Regional Museum Ust-Kamenogorsk), Dr. Z. Samashev (Astana) and Dipl. Arch. Olga Mjakisheva at the State Museum Almaty.

25 Recent investigations for metal components are carried out by M. Radivojevic (UCL, GB) and M. Frachetti for two Bronze Age sites (Dali and Begash) in the Tien Shan mountains of the Semirechye: we are grateful to both the colleagues for information (St. Louis, USA); for the Xinjiang Andronovo metals see also Mei, 2004; Chernykh, Kuz'minykh and Orlovskaya, 2004; Chernykh, 2009; Kuz'mina, 2004.

26 Tichonov, 1960, p.44; Kuz'mina, 1966, p.196; Avanesova, 1991, pp.35-49.

27 The variation of zinc and lead is best displayed by the large hoard of burst metal from Kurchum (11, tab. 2).

28 The hoards of Predgornoe as well as Issyk Kul and the LBA-settlement of Chaglinka are decisive for the LBA-dating: for the distribution of type D (after Avanesova): Kuz'mina, 1966; Orazbaev, 1970, p.141; Grishin, 1971, pl. 9; Avanesova, 1991, p.22, fig. 19.

29 Tichonov, 1960, pp.48-49; Sal'nikov, 1965, p.160; Chernykh, 1970, fig. 48 (28, 29, 36-38); Kiselev, 1949, pp.68-70, tab. XI (13); Grishin, 1971, tab. 11 (5, 8, 9); Chernikov, 1960, tab. LXIV (8).

30 The dagger KZ-214 seems a younger example of a series of "Karasuk daggers" dating to the 13th till the 11th century BC: Chernezov, 1953, p.51, pl. XIX (1); Chlenova, 1978, p.194, fig. 1 (10); Terenožkin, 1961, pp.135-137, fig. 91 (1, 2).

31 Spicin, 1909, 65-66; Krivcova-Grakova, 1955, p.60, fig. 13 (8); Orazbaev, 1958, p.278, tab. IX (3), X (9-11); Kuz'mina, 1965; Evdokimov, 1983, fig. 4 (10); Zdanovich, 1988, pl. 10G (17); Karabaspakova, 2011, pp.147-15.

32 Chernych, 1976, p.109; Avanesova, 1991, p.35; from Middle-Asia: Kuz'mina, 1966, pl. III (3, 4); from Semirechye: Karabaspakova, 2011, pl. 59 (1, 2, 5); from the northern forest steppe zone: Spicin, 1909, p.66, fig. 7 (8), from East Kazakhstan: Chernikov, 1960, tab. LXIII (2, 3); Ural: Tichonov, 1960, p.79; Southern Siberia: Grishin, 1971, p.22.

33 According to the elevated sulfur and iron contents of KZ-760. The Central Asian tin trade remains elusive as long as no tin ingots can evidence such by help of a geochemical pattern. For the method of tin isotope research see: Haustein, Gillis and Pernicka, 2010. It should be mentioned that also some of the LIA- and trace-element data especially from the site Dali in the Semirechye (excavation M. Frachetti) fit to Central Kazakhstan ores (according to Sb/As-levels): a kind thanks to Dr. M. Radivojevic, Cambridge for sharing this information.

34 It is difficult to estimate the effects of the Late Bronze Age climatic optimum (warmer and more arid) in all the regions involved (see for instance: Boroffka, 2013). However, it is obvious that Central- and East- as well as Northeast Kazakhstan (Forest steppe and steppe zones) saw an intensification of settlements and activities during the Late Bronze Age: Margulan, 1979; Parzinger, 2011.

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