

Nephrite-yielding Prehistoric Cultures and Nephrite Occurrences in Europe: Archaeomineralogical Review

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Abstract: *Nephrite-yielding prehistoric cultures in Europe have been using nephrite artifacts usually as axes or as ritual objects (including amulets). The nephrite artifacts are traced in prehistoric (Neolithic-Chalcolithic) cultures from the Balkans (end of 7th-5th mill. BC – “Balkan nephrite culture”) in South-East Europe and Sardinia (Italy; end of 5th-14th mill. BC) to Central and Western Europe (Southern Poland and the Alpine lakes area of Switzerland and Germany – 5th-3th mill. BC). The largest number of nephrite artifacts on the Balkans is reported from Bulgaria, and in Central Europe – from the Alpine lakes area, with the largest number known from Maurach. For certain prehistoric sites, the source of nephrite is not yet known. Archaeomineralogical studies are suggested to be made in this respect for tracing prehistoric trade routes and nephrite outcrops. Nephrite occurrences in Europe are known and reported from (in alphabetical order): Austria, Bulgaria, Finland, France, Germany, Italy, Poland, Russia (European part of the Russian Federation), Spain, Switzerland, Turkey (Turkish Thrace) and Ukraine. Almost all of the nephrite occurrences are of the serpentinite metasomatic genetic type and only in a few cases – of the dolomitic marble genetic type (Val Malenco, Italy; Scortaseo, Switzerland). Rare secondary glacier-related type nephrite finds in the northern part of Europe are also reported.*

Key words: nephrite, prehistory, Europe, archaeomineralogy

Introduction

Archaeomineralogy (archaeological mineralogy; mineralogical archaeology) is an important interdisciplinary science related to the study of archaeological and historical objects of a natural mineral or rock composition (Rapp, 2002; Kostov, 2007a). Of interest are also the sources of the stone artifacts (including in the broad sense the mineralogical, technological, economic and cultural approach: in prospecting, mining, processing, trade and influence). In certain cases archaeomineralogy is linked also to gemmology as a science for the study of natural and artificial raw materials which have been used for some sort of jewellery or decorative purposes since the dawn of humankind to modern times (mineral species and aggregates; rocks; bio-objects; glass and pottery, mineral pigments, as well as metals and alloys). Industrial minerals (salt, clays, abrasives, graphite etc.) also played an important role in the development of different tribes and civilizations and are also of interest for such an interdisciplinary study. Archaeomineralogy can be viewed as a major part of geoarchaeology as a broader scientific field of application of all the different branches of Earth sciences during archaeological searching,

prospecting and study of architectural monuments or single artifacts (archaeometry is another term for a much broader field of interdisciplinary studies in archaeology).

Nephrite $\square\text{Ca}_2(\text{Fe},\text{Mg})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$ is a Fe-Mg bearing Ca-silicate mineral with a double-chain structure, which is classified in the group of amphiboles (clino-amphiboles). It has a massive variety with an intermediate composition in the tremolite-ferroactinolite series, known mainly with a pale green or dark green colour, but can also be white, yellowish, brownish, or rarely with some other colours. In some cases, small black inclusions can be found in the fine green aggregates, which are attributed to magnetite and other spinel-type minerals. Its genesis is attributed mainly to metamorphic (metasomatic) processes in ultrabasic (serpentinite) or carbonate (dolomite marble) host rocks. The main genetic types of deposits of this gemmological material are related to the contacts of gabbroids, acid igneous or metamorphic rocks with ultrabasic rocks or to their contacts with dolomite marbles.

Nephrite and jadeite ($\text{NaAlSi}_2\text{O}_6$, another usually similar in colour pale greenish mineral, but a member of the group of pyroxenes) are frequently mistaken in general archaeological or historical articles, as the unified term ‘jade’ has been introduced a long time ago (up till modern times), when no precise mineralogical determination has been used (the word comes from the Spanish ‘piedra de ijada’ – stone of the loin, a name given to the green decorative mineral brought back to Europe from Central and South America by the XVIth century Spanish conquistadors). Jadeite has hardness on the Mohs scale 7-6.5, and nephrite – 6-5.5. The term chloromelanite, used in the past in archaeological and mineralogical literature, for describing different dark (F-rich) “jade”-like or eclogite rocks (and corresponding artifacts), must no longer be used.

Nephrite as a gemmological material has been esteemed by a lot of prehistoric and ancient cultures because of the toughness of the mineral due to its internal structure, composed of fine interlocking fibers. Recent observations, redeterminations and publications mainly on prehistoric rock and mineral artefacts from Bulgarian and other European museums has revealed a lot of nephrite samples, which have been mislabeled or unidentified from a mineralogical point of view. Nephrite artifacts are known from prehistoric sites in Bulgaria and on the Balkans in general in the period from the Early Neolithic (VII mill. BC) to the end of the Chalcolithic period (V mill. BC) when they disappear. The use of this precious material in this case can be attributed to specific population before the Bronze Age, with its specific lithic sources and mythological system in the discussed region. For gemmologists it is a surprise the precision and symmetry of the objects, as well as the perfection in the final polishing. The dominant quantity of nephrite artefacts are represented by small axes and chisels. Rarely are described different types of nephrite amulets and “distributors”. The regions of the Swiss lake dwellings (Switzerland; Germany) and southern Poland also display prehistoric nephrite tools, corresponding mainly to the Neolithic Age – in this case V-III mill. BC. Some other prehistoric nephrite artifact finds are reported also from other European sites of the same age. The sources of nephrite in Europe is been a topic for discussion since the end of the XIX century.

Nephrite artefacts in prehistory and the enigma of nephrite occurrences

The idea of Fischer (1880; 1881) for long distance origin and diffusion of the nephrite and jadeite artifacts in different cultures, including those in Europe, has been critically discussed by Meyer (1888) with some new data (including for *in situ* nephrite occurrences in Europe) within the so called “jade question” (*Nephritfrage* in German): “In nearly every part of the earth, especially America, Europe, Asia, and New Zealand, objects of a very hard and generally green stone, in the shape of hatchets, jewelry, etc., are found. They are discovered in mounds,

prehistoric settlements, etc. Similar objects are still worn by wild and uncivilized peoples, and also by the highly civilized. The origin of these objects is in many cases inexplicable, since Asia and Oceanica are the only places within our knowledge where the crude material may be found. It is now supposed that the American objects owe their origin to Asia, whence they were carried to Europe and by chance to, America, as well as directly from Asia to America. This is the opinion of Prof. H. Fischer, of Freiburg, in Baden, and of a great many other savants in Europe and in America. I shall try to prove that this theory is untenable and that the occurrence of these objects must be otherwise explained. The case is nearly the same with the objects of nephrite and jadeite of the Swiss prehistoric lake settlements (Pfahlbauten), whose native place is also looked for in Asia or even New Zealand, whereas the origin of the crude material may be very near. Sir John Lubbock argued for the Asiatic origin in 1865, and only lately Professor Fischer argued for the New Zealand origin. These claims rest solely upon the possibility that the Barmese jadeite and the Siberian or New Zealand nephrite might have been transported to the Swiss lakes, but the manner in which such transportation could have occurred is not at all obvious". Similar are the ideas of some other scientists in the late XIX century (c. other reviews: Westropp, 1881; Meyer, 1882; 1891; Hilton, 1888; Rudler, 1891).

Contemporary analyses and list of European nephrite occurrences is made in recent years (Nichol, 2004; Kostov, 2007a). On the Balkans, despite Bulgaria, nephrite artifacts are known from several Neolithic to Early Chalcolithic sites in Croatia, mainly along the Adriatic coast and they have been properly distinguished from the similar in colour jadeite artifacts (Petrić, 1995; Burić, 2000), which are common in western Europe. Other nephrite artifacts are reported from the European territory of Turkey (Özbek, 2010b) and probably in Greece, Albania, Montenegro and FYR Macedonia (Kostov, 2005a; 2005b; 2007a). The nephrite occurrences in prehistoric times on the Balkans raise a lot of questions. No related to artifacts deposits of nephrite are known in this region (with one possible exception in Turkish Thrace) despite of the favourable geological setting with a lot of ultrabasic outcrops (Montenegro, Serbia, Albania, Macedonia, Southern Bulgaria and Northern Greece). The well known nephrite deposits in Europe (Poland, Switzerland and Italy) are discovered in the late XIX and early XX centuries, and do not provide information or can not be related to trade routes on the Balkans. Another alternative is that the nephrite deposits on the Balkans have been exhausted or disappeared by some geological (earthquake; landslide) or other natural process (cover by soil and plants).

Some prehistoric polished stone axes with a nephrite composition are reported also from Poland (Foltyn et al., 2000; Gunia, 2000), related by some authors to local resources, and from Sardinia (Bertolino et al., 2002) and Sicily (Leighton, 1989) – with unknown source. The nephrite artifacts reported from the Alpine lake-dwellings in Switzerland and Germany also are under discussion, regarding the source of the mineral, as no contemporary analyses are made in order to fingerprint both raw material and artifacts.

Bulgaria

A number of about 40 nephrite artefacts are known from Bulgarian museums in the districts of Pernik (Kostov, Bakamska, 2004) and Kyustendil (Kostov, Genadieva, 2004) as well as from some other sites in Central and Southern Bulgaria (for example from the Kurdjali and Karanovo sites) (see Kostov, 2005a; 2005b; 2007a; 2010). Small axes and chisels with a fine polish represent the dominant quantity of nephrite artifacts. A unique and finely polished scepter, 36 cm long is supposed to be of the same material or nephritoid (Kostov, Bakamska, 2004; Kostov, 2007a). A fine shaped (12.1x0.7 cm size) nephrite 'hair pin' with three holes

without analogue has been found among the artifacts from the Middle Chalcolithic Varna II necropolis (Kostov et al., 2003; Kostov, 2007a) together with the earliest for the site golden beads and painted pottery (the famous gold treasures and faceted carnelian beads are linked to the large Varna I necropolis).

According to archaeological data, the nephrite objects are spread throughout the Neolithic and Chalcolithic period (VII-V mill. BC in Bulgaria). Some of them are masterpieces of art and as stage of perfection, thus pointing to the Balkans as a cradle of prehistoric gemmology. The nephrite carver's art has developed continuously from Neolithic times. Technically, the surfaces of the objects were gradually worn away and shaped through the patient application of some sort of hard abrasive medium (most probably fine quartz sand has served the purpose).

Among the artifacts frequently can be found ritual zoomorphic (frog-like; M-shaped) figurines-amulets, two of them well preserved with a 4-fold rotational symmetry from the Early Neolithic site at Kurdjali (Peikov, 1986, initially described as made of jasper; Kostov, 2005a; 2007a) and Kovachevo (Kostov, 2007a).

The Kovachevo Neolithic site is located in South-West Bulgaria not far from the Bulgarian-Greek border in the foothills of the Pirin Mountain. It has been studied during the past 25 years by a joint Bulgarian-French scientific team. A large number of stone artifacts, found during the 1988-2002 period, are studied for determination of their mineralogical and petrographical composition (including in cases X-ray powder diffraction and optical microscopy). Most of the samples are taken from the axes or chisels of different sizes and stages of preservation (small finds as stone amulets or jewellery objects have not been included). The three most intensively used raw materials (154 total number studied) are serpentinite (~50%), nephrite (or nephritoid) (~25%) and marble (~12.5 %) (Kostov, 2007a; Kostov, Machev, 2007). The serpentinites are dark-coloured, almost black. They are represented mainly by antigorite, in some cases with talc, and small inclusions of iron or other chrome-spinel-type oxides. The nephrite or nephrite-bearing (and nephritoid) artifacts are pale- to gray- and darkgreen in colour. So far, their number is considered to be the largest recorded number from prehistoric sites on the territory of Bulgaria. Their distribution together with similar artifacts from other prehistoric sites in Bulgaria and on the Balkans has been of special research interest, as no suitable nephrite deposits are reported in the investigated area (Kostov, 2005a).

Eighteen nephrite or nephrite-bearing artifacts (represented mainly by small axes of a Neolithic to Chalcolithic age) are recognized according to their physical properties among the stone artifact industry at the Karanovo archaeological site in Central Bulgaria (Kostov, Lang, 2005). Their colour varies from bright yellowgreen and pale green to dark green. The Tell of Karanovo is situated on the north-western periphery of the modern village Karanovo, district Nova Zagora. The site is located on the northern edge of the Upper-Thracian plane close to the southern slopes of the Sredna Gora mountain. The cultural layers, which include settlements from the beginning of the Early Neolithic to the end of Early Bronze Age III, reach a height of approximately 12.4 m.

The total number of nephrite artifacts on the territory of Bulgaria reaches about 100 (Table 1), and a lot of museum collections and new finds in the country are considered to be studied in the future.

Recently a small occurrence of nephrite is reported from the Ograzhden Mountain in South-West Bulgaria (Zidarov et al., 2010), but with no chemical correspondence and no significance for the prehistoric nephrite artifacts found in the region.

The study of Neolithic nephrite artifacts (and spinel-type inclusions) from 3 prehistoric sites along the Struma River valley (microprobe; PIXE) pointed out at least to two different sources for the raw material (Kostov, 2007a; Kostov et al., 2012). At least two different sources

can be suggested also for the nephrite artifacts, which are found in the Eastern Rhodopes area. The distribution of the nephrite frog-like zoomorphic amulets in Southern and Northern Bulgaria, points to some sort of importance of the green mineral as a prestigious material with evidence for long distance transport and distribution (in the case of Northern Bulgaria).

Prehistoric site (District)	Age	Type (number)
Galabnik (Pernik)	Early Neolithic	axe (13); sceptor* (1); distributor (1)
Unknown (Kyustendil)	Early Neolithic	axe (1)
Vaksevo (Kyustendil)	Early Neolithic	axe (1)
Krainitsi (Kyustendil)	Early Neolithic	axe (1)
Sapareva Banya (Kyustendil)	Early Neolithic	axe (4)
Kovachevo (Blagoevgrad)	Early Neolithic	axe (~20); amulet (3)
Eleshnitsa (Blagoevgrad)	Early Neolithic	amulet* (1)
Bulgarchevo (Blagoevgrad)	Neolithic	axe (2)
Dobroslavtsi (Sofia)	Early Neolithic	axe (1)
Kapitan Dimitriev (Pazardjik)	Early Neolithic	axe (2)
Karanovo (Stara Zagora)	Early Neolithic – Late Neolithic	axe (7)
Stara Zagora (Stara Zagora)	Early Neolithic	axe (4)
Azmashka Mogila (Stara Zagora)	Neolithic	amulet* (1)
Kazankuk (Stara Zagora)	Neolithic	needle (1); “distributor” (1)
Harmanli (Haskovo)	Late Neolithic	amulet (1)
Kardjali (Kardjali)	Early Neolithic	axe (2); amulet (2)
Ovcharovo-Gorata (Targovishte)	Early Neolithic	amulet (1)
Golyam Porovetz (Razgrad)	Early Neolithic	amulet (1)
Seidol (Razgrad)	Early Neolithic	amulet (1)
Ohoden (Vratsa)	Early Neolithic	axe (1); amulet (1)
Rousse (Rousse)	Chalcolithic	amulet (1)
Varna necropolis II (Varna)	Chalcolithic	needle (1)
Azmashka Mogila (Stara Zagora)	Chalcolithic	amulet* (1)
Karanovo (Stara Zagora)	Chalcolithic	axe (11)
Slatino (Kyustendil)	Chalcolithic	axe (2)
Svoboda (Stara Zagora)	Chalcolithic (?)	axe (1)
Topolnitsa (Blagoevgrad)	Chalcolithic	axe (2); amulet* (1)
Pernik-Krakra (Pernik)	Chalcolithic	distributor (1)
Yunatsite (Pazardjik)	Chalcolithic	needle (1)
Rakitovo (Pazardjik)	Chalcolithic	axe (1)
Vurhari (Kardjali)	Chalcolithic	axe; adze (4)

Table 1. Nephrite (or nephritoid*) artifacts (mainly axes) from the territory of Bulgaria (Kostov, 2007a; revised with additions)

Turkey (European part; Turkish Thrace)

Twenty stone tools made of nephrite and other rocks are mentioned from a Neolithic site near Kadi-Keuī (in a Stockholm museum; inv. N-13.985) in Turkish Thrace near the Bosphore (Janse, 1925). For the polished tools found in the Early Neolithic sites Hoca Çeşme (Özbek,

2009; 2010b) and Hamaylitarla (Özbek, 2010a), nephrite was preferred as the raw material for the most typical well-manufactured large-sized tools. The preliminary analysis and observations indicate that the nephrite source in the ophiolite belt near Şarköy was exploited and raw material from this locality has travelled more than 150 km to the North reaching the Neolithic sites in the regions of Stara Zagora and Haskovo in Bulgaria (Özbek, 2010c). No chemical analyses of nephrite artifacts are listed for the mentioned Neolithic sites and raw material both, thus this idea must be taken under question.

The nearest lithic analog with about 12 nephrite tools (in the collection of the Römisch-Germanischen Zentralmuseum, Mainz) from the Asian part (Asia Minor) of Turkey (from the area of the “Gyges Sea” or Marmora Gölü) are supposed to be of a Bronze Age (Zimmermann et al., 2003). In the same area (and age) are the some of the stone tools described by H. Schliemann (1881, p. 238-243, 445-451) at Troy (for the axes in the Russian museums c. discussion in: Zidarov, 2005).

Greece

Two small nephrite amulets are known from the prehistoric site Dikilitash (museum of Kavala), two axes from the Late Neolithic phase at Sitagroi (museum of Drama) and two nephrite or nephritoid axes from the Topolnitsa-Promachion site (museum of Seres) – all in Northern Greece (Kostov, 2007a). At the Early Neolithic (VII mill. BC) site Nea Nikomedeia, west of Tessaloniki are found 3 stone “frogs”, together with polished axes and chisels, all made of “local serpentine” with a greenish or bluish colour (Rodden, 1964, c. 294, Fig. 1; Mellaart, 1975, p. 251). About 10 small “greenstone” (possibly nephrite) axes and chisels from the Early Neolithic site Sesklo in Thessaly are on display in the National Museum in Athens. Marble and nephrite mace heads are mentioned at the sites Dimini and Sesklo (Siklósi, 2004).

Interesting possibilities of long-distance trade are raised by Nandris (1977, p. 296), who stated that the “green serpentine”, from which earstuds from the prehistoric sites Soufli, Argissa, and Nea Nikomedeia were carved was in fact a nephrite, coming from the high parts of the Pindus Range. This contradicted Rodden’s observation, according to which the earstuds from Nea Nikomedeia were carved on a green or blue serpentine coming from outcrops of the Vermion mountains that back the Macedonian Plain (Perlès, 2001, p. 287-288).

From the Metropolitan Museum of Art is known a single sample of nephrite tool (inv. N-26.31.505), labeled as Cretan and dated from the V-IV mill. BC.

FYR Macedonia

From the Neolithic site Anza I (Anzabegovo) is reported a “green stone” or “jade”, used as raw material for making small polished axes and adzes, as well as jewellery objects (the Bogoslav mountain is mentioned as a probable source for the “jade”; Gimbutas, 1974; Fig. 14.5). From the Anza II site is known a frog-like amulet, made of white marble and interpreted as a giving birth goddess (Mellaart, 1975; p. 259). Similar is the case with the description of lithic artifacts from the Vinca prehistoric site (Vassits, 1930). Artifacts as axes, made of nephrite or jadeite, are suggested to be frequent among the lithics in prehistoric settlements in the country (Garašanin, 1979, p. 99). Probably a nephrite amulet (inv. N-I-115), dated from the Early Neolithic, within a necklace of bone beads, is found at the Barutitsa site near the Anzabegovo village (*Nakitot nis vekovete*, 2001, cat. N-2, p. 25, 50).

Albania

In the western part of the Southern Albania among the artifacts of the Middle Neolithic site Cakran in the Fieri region one can identify at least one small axe and a chisel with a 4-5 cm length (Kostov, 2007 a; c. Korkuti, 1995, Taf. XLVIII, 16-17).

Serbia

On the territory of Serbia, near the Carpathian region, for some sort of small axes of jadeite and serpentinite is reported from the Neolithic sites Divostin and Grivats, not far from Kraguevaz (Titov, 1996, p. 34), as well as from some other sites as Velesnitsa and Vinca (Antonović, 2003, p. 91, 117-118, 123), but these raw materials are not mentioned by other authors (Šarić, 2002). The reported cases of nephrite axes from the earlier layers of Lepensky Vir (Antonović, 2003, p. 104; Table 9), have not been confirmed (personal communication of D. Antonović, Archaeological Institute, Belgrade). Probably the material of the artifacts is serpentinite. Fourteen possibly nephrite artifacts are described from the territory of Serbia, all spanning Early to Middle Neolithic in age (Antonović, Stojanović, 2009). Their source is not yet known.

Montenegro

As made from nephrite are at least two small axes, one of them with a trapezoidal form, and the other one with an asymmetrical form, both from the Neolithic settlement Kremeštica at the Lim River in the western part of the country (Kostov, 2007a; c. Marcović, 1985, Pl. XLV, 6-7).

Croatia

Nephrite artifacts have been reported from several supposed to be Late Neolithic to Early Chalcolithic (~3500 BC) sites in Croatia, mainly along the coast and islands of the Adriatic Sea and they have been properly distinguished from the similar in colour jadeite artifacts (Petrić, 1995; Burić, 2000). Some of the nephrite and “jade” (jadeite) finds are related to trade routes from northern Italy (Gargano peninsula and the Tremiti islands) over the islands Paragruza and Lastovo into the country along the valleys of the rivers Neretva and Bosna, and prehistoric axes are found in two regions – at Sinj, Okruglo, Tijarica and Budimiri Donji in the northwest part at Staro Čiče near Zagreb (Burić, 2000). A list of lithic tools with their localization on the territory of Croatia is given by Petrić (1995; p. 20; 2004; c. Marijanovic, 2002), who distinguishes the jadeite (10 in number) from the nephrite (9 in number) axes and adzes: at Vrbnik on the island of Krk, at Ražanac near Zadar, in the Sinj area and Marko’s Cave at the island of Hvar. All of the “jade” examples are considered particularly important and their crafting is a very high quality, so they also reflect the exceptional artistic achievements of the local Neolithic culture. Jadeite and nephrite are supposed to be materials from Northern Italy, and whether these axes came to Dalmatia finished or they were crafted locally is a question for further discussion and research – it looks as though they were made in the Dalmatia area (Petrić, 2004). According to other ideas, the nephrite from the Neolithic artifacts is from local sources (Paunović, 2001, p. 414). From the Historical museum in Pula are known several artifacts made of “jade” (nephrite or jadeite), found at Picugi, which are considered as from the Iron Age as dated by pottery.

Romania

A single case of a nephrite ring-amulet (from the Chalcolithic site Sălcuța–Piscul Cornișorului in Dolj County) is reported from the National Archaeological Museum in Bucharest (Ștefan, 2013).

Russia

Nephrite occurrences are known in the Ural Mountains: in Northern (Polar) Ural, at the Rai-Iz Massif – Nirdvomenshor (Suturin, Zamaletdinov, 1984) and in Central and Southern Ural at the Halilovskii Massif – Halilovskoe; Kozmodem'yanovskoe; Bol'shoi Bikilyar (Suturin, Zamaletdinov, 1984); Fakultetskoe and Pridorozhnoe (Arhireev, 2007). A single small nephrite axe is described from the 2A layer of the Neolithic Varfolomeevska site in the Saratov Region (Yudin, 2006; unpublished DSc thesis).

Ukraine

Two nephrite occurrences are reported from Ukraine: one in the Verhovtsevskii region – Alferovskoe (Soloninko et al., 1977) and another in the Krivoi Rog Bassin region – Annovskoe (Yatsenko et al., 1987).

The Borodino (Bessarabian) treasure (including 6 fine polished nephrite adze-hammers; middle of the II mill. BC; the source and raw material supposed to be from the Sayan Mountains in Asia) has been found in 1912 near the village Borodino in the former Bessarab Gubernia in Tsarist Russia (later Odessa district) (Popova, 1981). The nephrite artifacts have analogues in the 4 stone (as made from nephritoid; jadeite; lazurite) adze-hammers artifacts from Troy.

Poland

With the discovery of the local deposit of *in situ* nephrite at Jordanów at the massif Gogółów-Jordanów (old name Jordansmühl; Traube, 1885; Geschwendt, 1941; 1977; Heflik, 1968; Gunia, 2000; Heflik, Natkaniec-Nowak, 2001; Gil, 2013) and Reichenstein (Traube, 1887) near Wroslaw (the second occurrence is on the contact of granite and serpentinites at the villages Kłodzko-Złoty Stok; Gunia, 2000; Gil, 2013), several attempts are made to explain the existence of prehistoric nephrite artifacts with local for Europe raw material, and not as import from distant Asian localities. Contemporary analyses of the raw material are made for both the occurrences at Jordanów and Złoty Stok (Gil, 2013). According to Meyer (1892): “The occurrence of raw jade [nephrite] in Silesia (Germany) [now Poland], viz., near Reichenstein [now Kłodzko-Złoty Stok] was already known to Linnaeus (vide the 12th Latin edition of Gmelin, Nüremberg, 1777, 8vo, vol. i, p. 458), and has only recently been re-discovered by H. Traube”.

Both serpentinites and nephrite from Lower Silesia are used in human culture (Heflik, 2010). A review is made for the prehistoric nephrite tools found on the territory of Central, Western Poland and Upper Silesia (Southern Poland) (Geschwendt, 1941, S. 43, Abb. 7; 1977; Prinke, Skoczylas, 1980; Foltyn et al., 2000). The region in Southwestern Poland is not accepted by some scientists as possible source for the Polish and for some of the other European nephrite artifacts (Gunia, 2000).

Hungary

A single prehistoric artifact made of nephrite (from Ebenhöch) is attributed to the Jordanów source in Poland (Szakmany et al., 2011).

Austria

A single pendant from nephrite is reported from the Aurignacian (Late Lower Paleolithic) site Krems-Hundssteig in eastern Austria (Nigst, 2006; after Hahn, 1977).

At the end of the XIX century are known a few finds of nephrite in Steiermark – in the San valley and in the Mur valley near Graz (Berwerth, 1888; 1898; Sigmund, 1909; Teppner, 1915; Hilber, 1924; Hiden, 2000). Several analyses are made on artifacts from the Murtal valley and from Kili (Bauer, 1914). A nephrite occurrence (Zederhaus) is known in the Salzburg area, Lungau, Zederhaus valley (Niedermayr et al., 1985).

Czech Republic

In the Czech-Moravian region a single nephrite axe is reported from Tezhnize, Třebíč (Kostov, 2007a; cit. after Mrázek, Rejl, 1991). In northern Bohemia, at the contact of the Tanwald granite with an amphibole-plagioclase hornfels is initially described “nephrite” (Gränzer, 1933) or “nephritoid” (Bukovanská, 1992) hard rocks (known as “ironstone”; Eisenstein), used for Neolithic stone tools, but a proper petrographic investigation has suggested the better name amphibole hornfels (Klomínský et al., 2002).

The Lengyel Culture (Moravian Painted Ware Culture, MPWC) in Moravia and Mährisch-Österreichische Gruppe (MOG) in Austria is dated with a sample of nephrite artifact in the earliest phase for the area around the middle of the IV mill. BC (Kuča et al., 2009). Five polished artefacts made of nephrite are described in Moravia and one nephrite axe from Silesia (collection in the castle of Javorník) (Přichystal et al., 2011).

Slovak Republic

In the western part of the Slovak Republic on several prehistoric sites are found and studied spinel-hornblende-anthophyllite (nephritoid) schists (c. Illášová, Hovorka, 1995).

Germany

Nephrite finds are listed from Rügen at Zuklov, Potsdam, Schwemsal (Magdeburg) and Leipzig, as well as at Radautal in the Harz Mountain, Thuringia and the Fichtelgebirge (Bauer, 1914; Uhtig, 1914; Geschwendt, 1977, S. 232).

According to the monograph of Munro (1890), the number of nephrite artifacts at Maurach is about 500 and a total of 800 is estimated for the Überlingersee area (3-4 nephrite tools are known from Baden and Bavaria). The nephrite artifacts from the Bodensee region have been studied by Kalkowsky (1906b). According to the data of Tröltzsch (1902), the number of nephrite artifacts at the beginning of the XX century from the lake dwelling sites in the Alpine zone is: France (0), Germany (West and Central) (3), Bodensee area (1500), Switzerland (East) (29), Switzerland (West) (118), total (1650), and for comparison, the total number of the similar in colour jadeite and chloromelanite artifacts is correspondently 118 and 175.

Only for the site of Rosgarten the author mentions a total of 1371 nephrite (820 nephrite, 92 rhodonephrit, 459 weathered nephrite, etc.) artifacts, while only 42 jadeite, 46 chloromelanite, 79 eclogite artifacts. He finds out that the nephrite tools from the Bodensee lake dwellings are just like those from the Swiss lake dwellings of the West. He mentions the following sites with nephrite artifacts on the Überlinger-See: Litzelstetten, Dingeisdorf, Wallhausen, Bodman I, Ludwigshafen, Sipplingen, Nussdorf with 100 small axes from nephrite, Maurach – this site is known also as the largest nephrite workshop in Europe. The total number of nephrite tools is estimated on Lake Constance 1647, in Maurach (Germany) about 1000, and in Rosgarten (Switzerland) – 1347 artifacts.

Switzerland

The Swiss Neolithic lake dwellings are probably built between the end of the V mill. BC and middle of III mill. BC (Lake Constance – Switzerland; Bodensee – Germany). Because of the differences in the conditions of preservation of the sites, certain time periods (mainly during the IV mill. BC) have gaps, with no known sites (probably the villages were not preserved). In the monograph “The Lake-Dwellings of Switzerland” (Keller, 1866), nephrite artifacts are mentioned from prehistoric sites at: Meilen (p. 16; 18, 20; 25, 303; Pl. II, fig. 3), Robenhausen (p. 44-45; 55), Wangen (p. 61), Wauwyl (p. 85), Nussdorf (50 celts; p. 107), Sipplingen (in question; p. 120), Zug (in question; p. 125), Concise (p. 171), below Ekmatingen (p. 267), Lake of Inkwyl (p. 272) and Ebersberg (p. 372). The author summarizes the ideas on the origin of nephrite at the second half of the XIX century: “Professor von Fellenberg has done valuable service to the cause of science by a careful analysis of the nephrite found in the Swiss lake dwellings, both by deciding the true nature of this stone, and also by bringing the question to a point whether this nephrite is a native production or a foreign mineral probably brought out of the East. In an interesting paper, ‘Analysen einiger Nephrite aus denschweizerischen Pfahlbauten (Bern, 1865)’ he sums up his views on the origin of this stone in the following proposition: ‘We may with great probability affirm, so far as component parts are to be relied on to prove the identity or non-identity of two uncrystallised minerals, that the stone celts of Meilen and Concise are of genuine nephrite (whether of the New Zealand kind or not is doubtful), but that from Moosseedorf is of jade (vert oriental). One question yet to be decided is, whether the nephrite found in our lake dwellings may not also have been of Swiss origin, like the celts more commonly found with it, made of serpentine and siliceous schist, for the serpentine and chloritic schist mountains which occur in the New Zealand nephrite districts are found also in Switzerland, widely spread to a considerable extent, as in the Grisons and the Valais; and very possibly also may show segregations of nephrite. Still it has never yet been found here, so that the supposition of its eastern origin, as far as the proofs have hitherto gone, may perhaps be considered the more correct and probable.’ This view of Professor von Fellenberg, that nephrite is a foreign mineral, is borne out by the facts that hitherto no Swiss geologist has found it either *in situ*, or in the shape of gravel; and that no unworked pieces, nor any waste or chippings from it, have yet been found in the lake dwellings (Keller, 1866; p. 56-57). To his opinion, the nephrite, which was the mineral most valued for celts or hatchets, was imported already worked.

In the monograph of Munro (1890) are mentioned at least about 1200 nephrite stone tools (hatchets or chisels) in Europe with the dominating role of the Swiss lake dwelling sites as follows: Lake of Bienne (Gerlafingen – Oefeli; Locras), Lake of Neuchatel (La Tene; St. Blaise; Cortaillod; Chatelard; Concise; Font; Vouga; Chevraux), Lake of Inkwylersee, Lake of Morat

(Meyriez or Merlach), Lake of Zug (Wanwylersee), Lake of Pfäffikon (Robenhausen), Lake of Constance (Bodensee in Germany: Überlinger See – Nussdorf; Maurach; Olzreuthersee), Lake of Moosseedorfsee.

Nephrite-talc bearing rocks are known from the ophiolites at Scortaseo (Oberhalbstein) at the massif Puschlav (Poschiavo) in Grischun (Grisons; Graubünden) (Dietrich, de Quervain, 1968; Nichol, Giess, 2005c; c. Welter, 1911; Bauer, 1914), and other nephrite mineralizations are known at Salux, Val da Faller (Welter, 1911; Nichol, Giess, 2005a). Several other areas can be included as potential nephrite sources: Val de Bagnes, Les Haudères and the glacier Moiry in Wallis (Valais) (c. Preiswerk, 1926; Pétrequin et al., 2012); Cuolms, Bivio, valley Julia, valley Albula, Grischun (Grisons; Graubünden) (Stalder et al., 1993). Meyer (1892) mentions two small pebbles of nephrite from the Lake of Neufchatel. A total of twelve occurrences of nephrite are recorded in intimate association with serpentinitized peridotite within the Alpine ophiolite complex of Mesozoic age in the Oberhalbstein area of southern Switzerland, including two recently enlarged roadside occurrences in Val Faller, where exposures in the latter locality reveal contact alteration zones between serpentinites and the country rocks (Nichol, Giess, 2005a). The Scortaseo occurrence near the town of La Prese is the place in Switzerland, where the largest volume of nephrite is supposed to be found (Dietrich, de Quervain, 1968). It is related to the dolomitic marble genetic type.

France

In some early publications nephrite is mentioned from the valley of the Isere River (Welter, 1911; Gränzer, 1933). A new occurrence is reported from the island of Corsica. The continuous reaction zone between siliceous-marbles and serpentinites in ophiolites in northern Corsica is composed by a centimeter thick pale nephrite layer, followed by a thin wollastonite layer and a 5-20 cm thick dark zone composed of wollastonite, carbonaceous material, quartz, but no carbonates (Galvez et al., 2011).

Munro (1890) mentions a single case of a nephrite tool from Rheims. A prehistoric nephrite axe (labeled Carcassonne; inv. N-PRE2009.0.217.1) is described from the museum of Toulouse, and among other prehistoric samples is listed a big axe of Bernon type from Morbihan (inv. N-34175; Pétrequin et al., 2007).

Italy

In Italy nephrite occurrences are described in Southern Liguria at La Spezia, as well as in the region between Sestri Levante and Monte Rossa (Kalkowsky, 1906a; Steinman, 1908; Bauer, 1914; Nicol, 2003). Nephrite occurrence related to domomitic marble is studied also from the talc mines at Mastabia in Val Malenco, Sondrio province, northern Italy (Staub, 1925; Nichol, Giess, 2005b; Adamo et al., 2012; Bocchio et al., 2012). The same Ligurian deposits in the Genova Province are located in the Graveglia Valley, Monte Bianco, La Spezia (Antofilli et al., 1985) and Sestri Levante, Libiola Mine (Antofilli et al., 1983).

A nephrite artifact is mentioned from La Marmotta and two more artifacts in museums in the southern part of Italy, all with probable source from Swiss occurrences, because they differ in appearance with the nephrite from Liguria (D'Amico et al., 2003). Nephrite is described among the stone tools from Neolithic sites (Middle Neolithic Age 4000-3250 BC; disappear during the middle of the III mill. BC during the Monte Claro culture) in the western part of the island of Sardinia, its abundance estimated to be 95% among the axes or chisels, and the

rest 5% are determined as glaucophane schist, metadiabase, andalusite hornfels and phonolite (Bertorino et al., 2002). It is proposed that the nephrite is been imported probably as raw material from the region of northern Italy or from Corsica, but the first idea is not confirmed by the next investigations. Observed is a lack of jadeite and eclogite artifacts. Two groups of nephrite artifacts have been described depending on the presence or absence of epidot, and as main impurity despite chlorite are determined iron oxides. At the same place, at the Chalcolithic necropolis Angheln Ruju are found a lot of green small axes of greenstone. Nephrite Neolithic artifacts are found also in the north-west part of the island, but in both cases the source of the material is unknown (D'Amico et al., 2003).

A nephrite axe is reported from the museum in Castrogiovanui (Sicily) at the end of the XIX century (Schoetensack, 1897). The nephrite tool is described as tremolite or tremolite-antigorite in composition, which differs from the serpentinite (antigorite schist) or antigorite-tremolitic schist (Dixon в: Leighton, 1989, p. 152). Additionally, on the island are mentioned also axes made from sillimanite (c. Leighton, Dixon, 1992). As possible source for some of the artifacts is suggested in the Calabria region. The total number of polished nephrite stone tools from Italian sites is estimated to be 28 (D'Amico, Starnini, 2006): 1 (Latium), 2 (South Italian museums), 1 (Sicily) and 24 (Sardinia). The artefacts do not correspond to the raw material from the Ligurian site (Kalkowsky, 1906a) and a probably provenance from Switzerland (Grisons) is suggested (D'Amico et al., 2003).

Spain

Nephrite is reported from the contact of granite dykes with serpentinites of the Ronda peridotites (Betic Cordilleras, Southern Spain) (Tubía et al., 2009).

United Kingdom

Investigations are underway at Balta in the Shetlands, Scotland on ortho-nephrite in an ophiolite complex of Cambrian age (Nichol, 2004). Several finds of nephrite artifacts (axes) from sites on the British Isles are recognized as imported from New Zealand in modern times (Sheridan et al., 2011).

Belgium

The material of a single find at Ouffet “Houp-le-Loup” (province of Liège) of a Neolithic (second half V – beginning of III mill. BC) nephrite axe-head-pendant is attributed to a Swiss source, most probably from the Valais area (Delaitte et al., 2010-2011).

Finland

In Finland are described nephrite, anthophyllitic nephrite and azbest from Paakila, in the region Tuusniemi (Riman, 1936), as well as nephrite from the Stansvik iron-ore mine (Nichol, 2004). No information is available for nephrite-bearing artifacts.

The nephrite-yielding cultures and the enigma of the nephrite sources

Nephrite artifacts are known from prehistoric sites in Bulgaria since the Early Neolithic and they ‘disappear’ at the end of the Chalcolithic period. The nephrite occurrences in

prehistoric times on the Balkans raise a lot of questions. No nephrite deposits are known cited in publications in this region despite of the favorable geological setting with a lot of ultrabasic (serpentinite) exposures (Montenegro, Serbia, Albania, FYR Macedonia, southern part of Bulgaria and northern part of Greece). The well known European nephrite deposits in Poland (Traube, 1885; 1887), Switzerland (Dietrich, de Quervain, 1968; Stalder et al., 1993) and Italy (Kalkowsky, 1906a) have been discovered in the late XIX and early XX centuries, and do not provide information or can not be related to trade routes on the Balkans in prehistoric times. Another alternative is that the nephrite deposit or deposits on the Balkans have been exhausted or disappeared due to some geological (earthquake; landslide) or other natural process (soil; active vegetation). The use of this precious material can be attributed to a population with its specific mythological system in the discussed region. It is a surprise for gemmologists the precision and symmetry of the objects as well as the perfection in their final polishing. The nephrite artifacts are considered among the earliest in history according to their variability, perfection and style. The symbolism of the zoomorphic (frog-like) nephrite or nephritoid figurines has to be explained in terms of prehistoric mythology and colour impact (Rodden, 1964; Hansen, 2003; Kostov, 2005a; 2007a).

As the Early Neolithic on the Balkans is dated about the VII-VI mill. BC, thus the observed nephrite objects as part of the Balkan prehistoric area are considered representatives of one of the earliest “nephrite cultures”, before the well known “nephrite cultures” (Hemudu; Hongshan; Liangzhu; Longshan) in Neolithic China (Wen, Jing, 1992) or the Neolithic to Bronze cultures (Kitoi; Glaskovo) in the Angara-Baikal region of the Russian Federation (Okladnikov, 1950). In this respect it is interesting to have a precise age of the Neolithic Xinglongwa site in China, from where a few nephrite objects have been reported as the “earliest refined ‘jade’” (Yang, Liu, 2007).

Contemporary microprobe or other chemical and spectroscopic analyses of nephrite artifacts from European sites are published for samples from Italy (Sardinia) (Bertolino et al., 2002), Bulgaria (Kovachevo; Galabnik; Bulgarchevo) (Kostov, 2007a; 2007b; 2009; Kostov, Machev, 2008; Kostov et al., 2012), Hungary (Szakmany et al., 2011) and Switzerland (Bielersee – Kostov, 2007a; 2007b). Contemporary mineralogical data (analyses of composition) for raw material are published for samples from the Polish occurrences (Jordanów; Złoty Stok) (Kostov, 2007a; 2007b; Delaitte et al., 2010-2011; Kostov et al., 2012; Gil, 2013), Switzerland (Scortaseo – Kostov, 2007a; 2007b; Valais and Grisons – Delaitte et al., 2010-2011) and Italy (Val Malenco) (Adamo et al., 2012; Bocchio et al., 2012), as well as for the recently discovered occurrences in Bulgaria (Ograzhden Mountain) (Zidarov et al., 2010) and Spain (Tubía et al., 2009). A future detailed correlation and comparison of mineralogical and geochemical data for nephrite artifacts and nephrite occurrences both is needed in order for the elucidation of the sources of nephrite and trade routes in prehistory. International cooperation and interdisciplinary studies are welcomed in this respect.

Conclusion

A high number of nephrite prehistoric artifacts is recorded on the territory of Bulgaria (mainly South-Western Bulgaria) and adjacent Balkan states (Neolithic-Chalcolithic; end of VII-V mill. BC for the region), as well as of Italy (Sardinia, V-IV mill. BC), Poland and in the Alpine lake dwellings area (Switzerland-Germany; end of V-III mill. BC). The question about the *in situ* nephrite deposits in Europe and some possible clues for finding such deposits from a geological point of view on the Balkans must be discussed. Suitable geological conditions for

nephrite formation are serpentinitized ultrabasic rocks and ophiolitic belts, which are known in the geological setting of different countries. The observed nephrite artifacts on the Balkans are considered among the earliest recorded in history according to their variability, perfection and style. The symbolism of the zoomorphic (frog-like) figurines (amulets) can be explained in terms of prehistoric mythology and colour impact. The uniqueness of the green gemmological material (or similar substitutes) has to be studied with joint mineralogical and archaeological efforts. The nephrite-yielding cultures “move” from Eastern to Central and Western Europe throughout the centuries (end of VII mill. BC on the Balkans to III mill. BC in the area of the Alpine lake dwellings). The Balkan “nephrite culture” in prehistoric Europe has to be declared as one of the earliest in human civilization not only on the continent, but worldwide.

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