Quaternary International xxx (2016) 1–9

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

The identification of archaeological obsidian sources on Kamchatka Peninsula (Russian Far East) using geochemical and geological data: Current progress

Andrei V. Grebennikov [a, b, *], Yaroslav V. Kuzmin [c, d]

[a] Far Eastern Geological Institute, Far Eastern Branch of the Russian Academy of Sciences, 100-Letiya Vladivostoku Ave.159, Vladivostok 690022, Russia
[b] Far Eastern Federal University, Sukhanova St. 8, Vladivostok 690950, Russia
[c] Institute of Geology and Mineralogy, Siberian Branch of the Russian Academy of Sciences, Koptyug Ave. 3, Novosibirsk 630090, Russia
[d] Laboratory of Mesozoic and Cenozoic Continental Ecosystems, Tomsk State University, Lenin Ave. 36, Tomsk 634050, Russia

ARTICLE INFO

Article history:
Available online xxx

Keywords:
Obsidian sources
Geochemistry
Volcanic geology
Aarchaeology
Kamchatka
Russian Far East

ABSTRACT

The current state-of-the-art of provenance studies for archaeological obsidian on Kamchatka Peninsula is presented. Prehistoric people widely used obsidian as a raw material for making tools, and acquired it from several primary sources. The exact position of seven sources allowed us to understand the general features of obsidian geochemistry and tectonic position of obsidian-bearing volcanic formations. This also made it possible to suggest the localization of seven still unknown sources for archaeological obsidian on Kamchatka. Verification of our preliminary conclusions can be made by fieldwork in selected areas.

1. Introduction

Nowadays, research on obsidian provenance is integral to the study of human–environment interaction, especially in terms of lithic raw material resources (e.g., Shackley, 2008). In Northeast Asia, covering Japan, the Russian Far East, Korea, and Northeast China (or Manchuria), the number of research groups working in the field of archaeological obsidian sources has increased dramatically since the 1990s. As a result, there are several edited volumes with data generated since the early 2000s (Kuzmin and Popov, 2000; Kuzmin and Glascock, 2010; Ono et al., 2014). The Kamchatka Peninsula in the northern part of the Russian Far East is one of the promising regions due to the large number of primary obsidian sources and the extensive use of this raw material in prehistory (e.g., Kuzmin et al., 2008; Grebennikov et al., 2010, 2014).

However, Kamchatka remains less studied when compared to the neighboring parts of Northeast Asia, mainly due to the difficult terrain. This calls for particular attention to this region using all available data, mainly from the geology and geochemistry of volcanic rocks. This paper presents the current understanding of the peculiarities of the geochemistry and chronology of archaeological obsidians on Kamchatka.

2. Material and methods

Obsidian was widely used by prehistoric populations of Kamchatka, and this was one of the major kinds of raw material for tool-making (Dikov, 1996, 2003). Most of sites considered in this paper belong to Neolithic and Paleometal stages of Kamchatkan prehistory dated to ca. 6000–300 BP (Grebennikov et al., 2010; Kuzmin et al., 2008; see also Kuzmin, 2000).

Since the early 2000s, our team has collected about 500 samples of Kamchatkan obsidian, from both archaeological and geological contexts. All specimens were tested by Neutron Activation Analysis (NAA) at the Research Reactor Center, University of Missouri (MURR), in Columbia, MO, USA (Grebennikov et al., 2010). At first, the concentrations of seven short-lived elements (Al, Ba, Cl, Dy, K, Mn, and Na) were established for all samples using only short irradiation. Afterwards, long irradiation for 162 specimens allowed us to measure an additional 21 medium and long-lived elements (La, Lu, Nd, Sm, U, Yb, Ce, Co, Cs, Eu, Fe, Hf, Rb, Sb, Sc, Sr, Ta, Tb, Th,

* Corresponding author. Far Eastern Geological Institute, Far Eastern Branch of the Russian Academy of Sciences, 100-Letiya Vladivostoku Ave.159, Vladivostok 690022, Russia.
E-mail addresses: greandr@hotmail.com (A.V. Grebennikov), kuzmin@fulbrightmail.org (Y.V. Kuzmin).

http://dx.doi.org/10.1016/j.quaint.2016.03.020
1040-6182/

Zn, and Zr). Statistical grouping of the data obtained was performed using the methodology developed by Glascock et al. (1998), which was successfully employed in other parts of the Russian Far East since the 1990s (e.g., Kuzmin et al., 2002a, 2002b; Kuzmin and Glascock, 2007; Glascock et al., 2011).

As a result, 16 geochemical groups of obsidian were established (Fig. 1). Each group reflects the composition of an individual obsidian source, with its unique geochemical signature. Fourteen out of 16 groups are identified among archaeological specimens, and seven of these groups also have geological source samples; two groups are known only from geological sources (Grebennikov et al., 2010).

These data allow us to identify the primary obsidian localities used by the ancient populations of Kamchatka. When we have samples from both the primary source and the prehistoric site, it is possible to find out from where obsidian was acquired. There are seven locales with high quality obsidian from which prehistoric people collected valuable raw material. Data on the locations of these obsidian sources (labeled as "known") made it possible to understand the general peculiarities of their geochemical composition in relation to the major tectonic zones of the region (Grebennikov et al., 2010). Based on these data, we separated the obsidian geochemical groups into three major geographic clusters: 1) Central Range; 2) Eastern Range; and 3) southern Kamchatka (Fig. 1). Each of them is characterized by its own history of volcanism (Grebennikov et al., 2014).

The locations of seven other sources (labeled as "unknown") remains unclear. Keeping in mind that there are at least 30 well-known obsidian locales on Kamchatka (e.g., Grebennikov et al., 2010), this is not surprising. Our team was so far able to obtain reference samples from about 27% of them (Grebennikov et al., 2014: 96). A similar situation exists in Alaska where only a small portion of sources for archaeological obsidian has been pinpointed (e.g., Reuther et al., 2011). Nevertheless, data on the geochemical zoning of known Kamchatkan sources, as established by our team (see Grebennikov et al., 2014), are now crucial in order to suggest the approximate location of unknown ones.

Judging from the geographic distribution of archaeological sites with obsidian from known sources, it is possible to assume the spatial position of primary localities in relation to prehistoric sites. For the most widely used groups KAM-03 (Itkavayam) and KAM-05 (Payalpan), archaeological sites are usually situated around the sources (Fig. 2). In some cases, however, sites are located quite far away from them, with distances of up to 500–600 km (Grebennikov et al., 2010). These spatial patterns can be used to suggest the position of unknown obsidian sources.

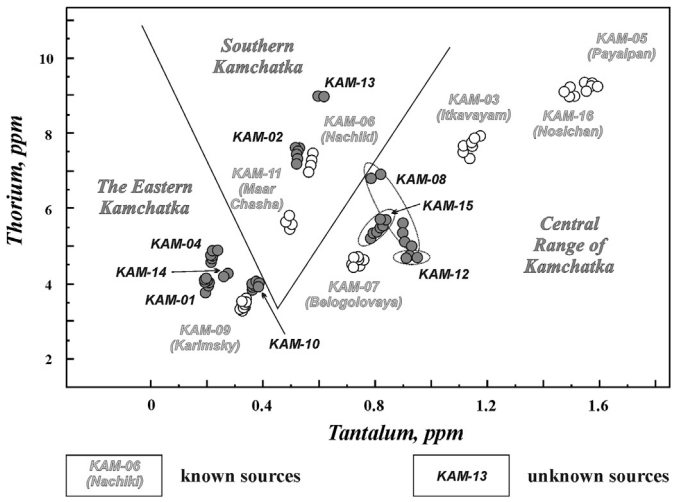

Fig. 1. Geochemical groups of Kamchatkan obsidian (after Grebennikov et al., 2014; modified).

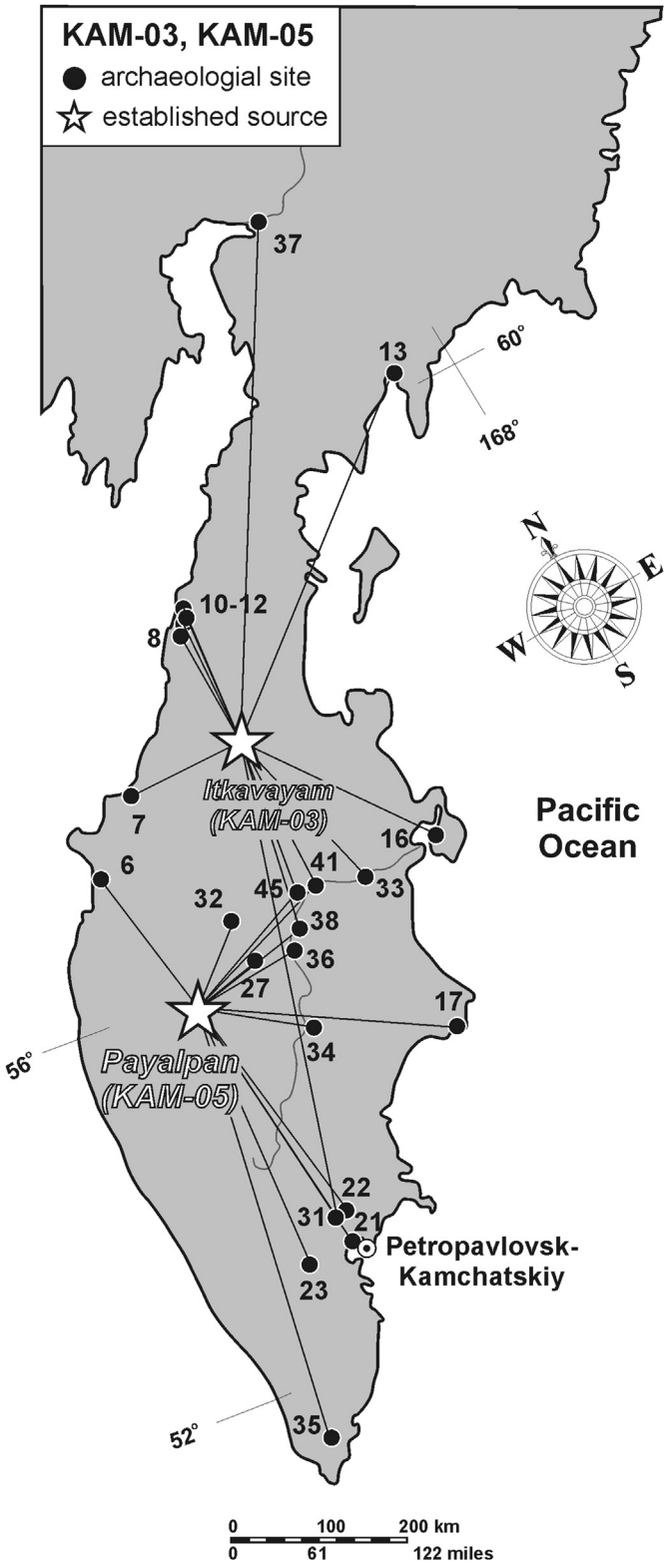

Fig. 2. Distribution of obsidian from two primary sources, KAM-03 (Itkavayam) and KAM-05 (Payalpan), in archaeological sites on Kamchatka. In Figs. 2–9, site numbers correspond to those in Grebennikov et al. (2010).

Please cite this article in press as: Grebennikov, A.V., Kuzmin, Y.V., The identification of archaeological obsidian sources on Kamchatka Peninsula (Russian Far East) using geochemical and geological data: Current progress, Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.03.020