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New data on source characterization and exploitation of obsidian from the Chikiani area (Georgia)

Figure 1: Location of Mt. Chikiani in south Georgia (drawing by P. Biagi)

Introduction

This poster presents the results obtained from two geological surveys carried out in 2012 and 2014 along the slopes of Mt. Chikiani (fig. 1). Sixty-nine samples retrieved from 20 different points (fig. 2), precisely geo referenced, have been chemically characterized using LA-ICP-MS at the IRAMAT-CEB laboratory in Orléans.

The aim of this project was:
- to improve our knowledge of the raw material resources exploited in prehistoric times,
- to check the chemical homogeneity of Chikiani's obsidian flows,
- and to identify the origin of some obsidian artifacts characterized by high barium contents.

Our results highlight the compositional variability of Chikiani's obsidian which can be divided into 2 or 3 main groups, characterised by different percentages of barium and zirconium. Their implications in the prehistory of the Caucasus and its related regions is important and contribute to the redefinition of the complex pattern of procurement and exchange of Caucasian obsidian in prehistory.

The Chikiani volcano

The Chikiani volcano (2417m) is located near lake Paravani, in Southern Georgia, some 85 km west-southwest of Tbilisi (fig. 1).

At Chikiani, obsidian is abundant and easy to access. The only limit to exploitation being the thick snow cover that lasts more than six months.

Its quality is excellent, very homogeneous and without inclusion. Several varieties are found: colorless, uniform black, banded black and red, red-brown, mottled brown and black, mottled yellow and brown, etc.

Obsidian belongs to an eruptive phase dated some 2.8 Ma. It is spread all over the dome of the volcano, and extends in a large flow to the north-east.

Secondary sources are also available along the Chrami river, which receives many obsidian blocks from its tributaries running down from the Chikiani slopes.

Figure 2: Distribution map of the Points from which samples were collected for characterization in 2012 and 2014 (drawing by P. Biagi) Two brief surveys were made in 2012 and 2014. The first survey (6 sampling points, 12 samples) started from the northern, lowermost foot of the mountain, moving up toward its top, and then down along the southern slope. A more systematic research was carried out in 2014 (14 sampling points, 57 samples) where the eastern slope of the volcano was systematically surveyed starting from its southern foot, moving up to north-east (figs. 3 & 4)

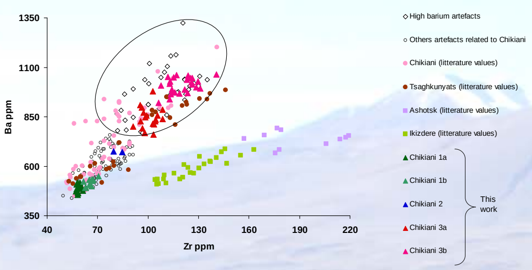

Figure 5: Binary diagram for the Zr-Ba contents of the barium rich Caucasian obsidian compared to the barium rich artifacts group. Litterature values are from Chataigner and Gratuze 2014, Blackman 1998, Frahm 2010, Keller et al. 1996, Le Bourdonnec et al. 2012, Kloess et al. 2012, Delerue 2007 and pers. comm. from Bressy and Keller.

Chikiani obsidian, a short state of the art

Previous studies tend to show that the obsidian taken from the Chikiani dome form a single group characterized by low zirconium and high barium contents. A continuous variation of Ba and Zr concentrations, corresponding to the progressive evolution of the magma between the successive flows, is observed.

However, unpublished research works revealed the existence of an obsidian artifacts compositional group, characterized by a high barium content (900 to 1200 ppm). This group appears to be significantly different from any precisely described Caucasian obsidian group (fig. 5).

All these artifacts which have been analysed at the IRAMAT-CEB originate from different archaeological sites located in Azerbaijan, Armenia and Georgia, and dated from the 5th millennium BC.

The comparison between the compositions of these artifacts and published and unpublished data on Chikiani's obsidian shows that in fact all the Chikiani obsidian samples do not probably form a chemically homogenous source as stated up to now.

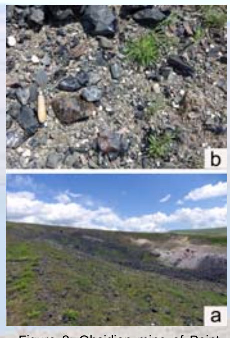

Figure 3: Obsidian mine of Point 2014-3 (a), and obsidian bombs and flakes from the sampled point (photograph by P. Biagi)

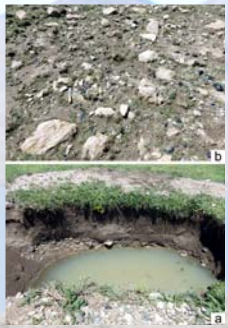

Figure 4: Different characeristics of Point 2014-8 (a) and 2014-6 (b), from which obsidian samples were retrieved (photograph by P. Biagi)

Results

The analytical results obtained on the sixty nine obsidian samples allow to split them into three main chemical groups characterized by a continuous variation of the Ba and Zr concentrations (tab. 1 & fig. 5).

A similar pattern, highlighting more discrete sub-groups, is observed for Y/Zr and Nb/Zr ratios and Ti – Mn contents (fig. 6 & 7).

The three main groups have different rare earth element distribution trends (fig. 8) which tend to show that the difference between Chikiani 1a and 1b is not as pertinent as the difference between Chikiani 3a and 3b, which could be interpreted as originating from different obsidian flows.

Our new data demonstrate the existence of at least three main obsidian chemical groups at Chikiani:

- Group 1 (the lowest REE trend, and barium content) is similar with the one defined by the samples analysed by Bressy (personnal communication), and Chataigner & Gratuze (2014),

Group 2 (the intermediate REE trend and barium content) matches the samples analysed by Le Bourdonnec (Le Bourdonnec et al. 2012),

- Group 3 (the highest REE trend and barium content) correspond to the samples analysed by Blackman (1998) and to the high barium samples analysed by Keller (1996 and personnal communication).

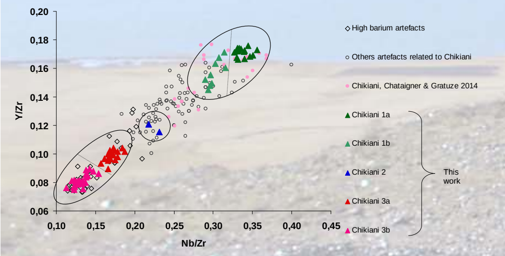

Figure 6: Y/Zr-Nb/Zr ratios of our geological corpus compared to those of archaeological artifacts originating from Chikiani (Gratuze unpublished values).

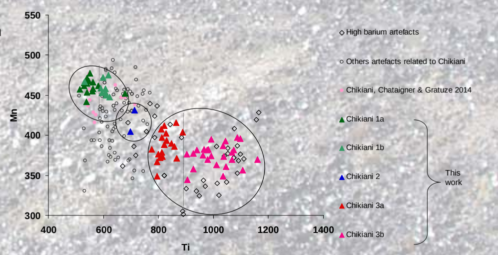

Figure 7: Binary diagram of Mn -Ti contents for our geological corpus compared to those of archaeological artifacts originating from Chikiani (Gratuze unpublished values).

If we compare the composition of the artifacts originating from Chikiani, with our data it appears that a large majority of them could be related to groups 1b, 2 and 3b rather than to groups 1a and 1b (figs 5-7).

A very good agreement between the high barium artifacts and groups 2 and 3b is observed. However, many artifacts tend to occupy an intermediate position between group 3a and group 2 or between group 2 and group 1b. This feature argue to the necessity to undertake a more exhaustive survey of the Chikiani area.

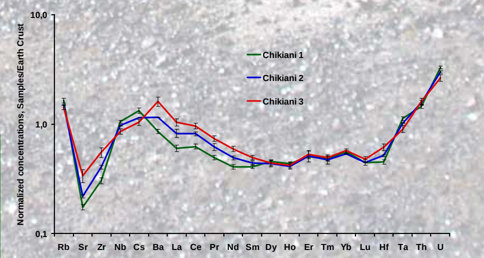

Figure 8: Rare earth element and extended trace normalized plots for the main chemical groups of our geological corpus. Earth crust normalization from K.H. Wedepohl (1995)

Figure 9: Distribution map of the different obsidian sub-groups identified from the sampled points (drawing by B. Gratuze and P. Biagi)

Chemical groups and sub groups		Sr/Zr/Ba content range in ppm
Chikiani 1	a	Sr: 52 – 62 Zr: 57 – 63 Ba: 455 – 516
	b	Sr: 55 – 63 Zr: 62 – 71 Ba: 490 – 549
Chikiani 2		Sr: 71 – 75 Zr: 80 – 85 Ba: 673 - 674
Chikiani 3a	a	Sr: 73 – 117 Zr: 91 – 109 Ba: 760 – 978
	b	Sr: 108 – 137 Zr: 106 – 141 Ba: 920 – 1063

Table 1: Strontium, zirconium and barium contents of the different obsidian sub-sub-groups

Conclusion

The characterization of the obsidian specimens collected during the 2012 and 2014 surveys evidence the existence of at least 3 main obsidian chemical groups at Chikiani. The possible presence of different eruptive phases was already pointed out (Nomade et al. 2015). An age ranging from 2.4 Ma to 2.8 Ma being associated with the studied samples presenting respectively the lowest and highest barium content (638 ppm and 682 / 727 ppm). These datings are however still discussed (Lebedev and Vashakidze 2015).

The perfect match observed between the chemical composition patterns of the high barium artefact groups and those of groups 2, 3a and 3b, confirms the attribution of these artefacts to the Chikiani obsidian outcrops.
According to the available data, Mt. Chikiani obsidian sources were exploited throughout a long period, ranging from the Early Neolithic to the Middle Bronze Age. The supply zone covers a wide territory. Nevertheless, at present little is still known of the modes of exploitation of the different Chikiani flows, and even less of the precise location of the exploitation zones during the different periods.

The new characterizations presented here, according to which three Chikiani obsidian groups have been identified and precisely geo referenced for the first time (fig. 9), help interpret the complexity of the role played by Caucasian obsidian exploitation and its modes of circulation inside and outside this Caucasus.

Reference

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Acknowledgment

Many people contributed in different ways and at different stages to make this work possible. Among them we would like to express our gratitude to C. Chataigner, B. Lyonnet, B. Helwing, D. Maynard, E. Rova, for allowing us to study and analyse the archaeological samples from their archaeological projects: ANR-DFG research programs 'Ancient Kura' and 'Kura in motion', The BTC Pipeline Archaeological Excavations in Azerbaijan project, the Shida Kartli Region project. We would like to thank also C. Leandri-Bressy and J. Keller for allowing us to use their unpublished data on Chikiani obsidian.
Special thanks are due to Professor V. Licheli (Tbilisi State University, GE) for all his assistance and support, and for providing facilities and transport to carry out the 2012 and 2014 surveys. The 2014 fieldwork was possible thanks to the financial support of EURAL Gnutti (Rovato, Brescia, I) and the Ca' Foscari University, Venice, ADIR funds, with many thanks.

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