Source Identification of Obsidian Projectile Points from Kaman-Kalehöyük

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1. INTRODUCTION

The archaeological study of obsidian, especially source identification of artefacts, has been one of the most successful archaeological science approaches, providing important information on obsidian procurement in ancient times (Williams-Thorpe 1995). Several researchers including present authors, have carried out research on source identification of archaeological obsidians in the Central Anatolian region (Bigazzi et al. 1998; Blackman 1984; Carter et al. 2006; Kobayashi 2003; Kobayashi and Mochizuki 2001; Kobayashi and Mochizuki 2002; Mochizuki 1997). These studies shed light on important aspects of human activities, such as trading or interaction. However, most studies have mainly addressed analyses of lithics, the so-called debitage, whereas little analysis has been done on formal tools, including arrowheads, projectile points or blades. Such valuable tools might have been treated in different a way from non-valuable goods. Hence, source identification of formal tools should also be conducted.

In this study, six projectile points excavated from Kaman-Kalehöyük were non-destructively analysed using X-Ray fluorescence analysis (XRF).

2. SAMPLES

2-1. Source materials

Source samples were collected from outcrops existing in Central and Eastern Turkey. Table 1 shows the list of obsidian sources analysed in this study. Locations of each source were reported at somewhere by present authors (ibid. 2003).

2-2. Artefacts

All projectile points were excavated from Kaman-Kalehöyük (see Fig.1 and Table 2). All artefacts were non-destructively analysed using X-Ray fluorescence analysis (XRF).

Table 1 Obsidian sources in Central and Eastern Turkey

<table>
<thead>
<tr>
<th>No</th>
<th>Central Anatolia</th>
<th>Name Abbr.</th>
<th>Location name</th>
<th>latitude (N)°'</th>
<th>longitude (E)°'</th>
<th>SN*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KMMR KMR Kaletepe, Kümürcü</td>
<td>Kömürcü (Göllü Dağı East)</td>
<td>KMR</td>
<td>20°29.07'</td>
<td>34°19.42'</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>KYR Kayırılı</td>
<td>Kulebatı, Gösterli Köyü</td>
<td>KYR</td>
<td>38°30.87'</td>
<td>34°38.78'</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>NNZ Nenezi Dağı Bekarlar</td>
<td>Kayırılı</td>
<td>NNZ</td>
<td>38°31.60'</td>
<td>34°38.78'</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>TLC Tulece Tepe, Boğazköy</td>
<td>Tulece Tepe</td>
<td>TLC</td>
<td>38°31.60'</td>
<td>34°38.78'</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>ACG Gobekli, Karapınar</td>
<td>Acıgöl</td>
<td>ACG</td>
<td>38°30.87'</td>
<td>34°34.40'</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>EZC Boztepe, Karakaya</td>
<td>Erzincan</td>
<td>EZC</td>
<td>39°43.753'</td>
<td>39°41.161'</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>OMT Omeretepe, Erzurum</td>
<td>Omeretepe</td>
<td>OMT</td>
<td>39°53.527'</td>
<td>41°06.167'</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>PSL B dere, Pasinler</td>
<td>Pasinler</td>
<td>PSL</td>
<td>40°04.134'</td>
<td>41°37.313'</td>
<td>26</td>
</tr>
<tr>
<td>9</td>
<td>IKZ Ikızdere, Rize</td>
<td>Ikızdere</td>
<td>IKZ</td>
<td>40°48.438'</td>
<td>40°39.729'</td>
<td>21</td>
</tr>
<tr>
<td>10</td>
<td>SRK1 Mescitli, Sarıkamış</td>
<td>Sarıkamışlı</td>
<td>SRK1</td>
<td>40°12.816'</td>
<td>42°39.076'</td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>SRK2 Hamamlı, Sarıkamış</td>
<td>Sarıkamışlı</td>
<td>SRK2</td>
<td>40°17.999'</td>
<td>42°41.699'</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>MYD</td>
<td>Meydan Daği</td>
<td>MYD</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>PH</td>
<td>Süphan Dağı</td>
<td>PH</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>NRT</td>
<td>Nemrut Dağı, Tatvan, Bitlis</td>
<td>NMR</td>
<td>38°36.609'</td>
<td>42°16.856'</td>
<td>22</td>
</tr>
<tr>
<td>15</td>
<td>MUS</td>
<td>Muş</td>
<td>MUS</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>BGL</td>
<td>Bingöl</td>
<td>BGL</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* : Sample Number
recovered from stratum II or III which belong to the first or second millennium BC. Although the context of each artefact was not examined in detail, these tools were probably originated from older layers because it is unlikely that this type of tool was used after the Middle Bronze Age (Rosen 1984). One of the authors has discussed projectile points excavated from this site in another paper (Kobayashi 2004), and according to that, the tools might belong to the Neolithic Age, though the oldest stratum that has been confirmed so far is the Early Bronze Age at Kaman-Kalehöyük.

3. EXPERIMENTAL PROCEDURE

All source samples were struck to create a fresh and flat surface. Artefacts were washed in water and were non-destructively analysed.

Analysis was carried out at the Japanese Institute of Anatolian Archaeology in Kaman, Turkey using an EDXRF spectrometer, SEA-2010 manufactured by Seiko Instruments Inc. with an Rh X-ray tube and Si (Li) detector. Applied voltage and current were 50 kV and 6 to 11µA. Each sample was analysed for 300 seconds in an air atmosphere. Nine elements, Mn, Ca, K, Ti, Fe, Rh, Sr, Y and Zr were identified and their XRF intensities were obtained. Quantitative data were calculated from the intensities using the fundamental parameter method with a geological standard, JG-1. For Mn, Ca, K, Ti and Fe, the concentration of each element was calculated as an oxide. Table 3 shows the result of quantitative analysis of the geological standard (JG-1).

4. CLASSIFICATION METHOD

Using Mochizuki’s method (ibid. 2003; ibid. 1997), Central and Eastern Anatolian obsidian sources can be clearly distinguished into groups. The method utilises unique indices that relate to the concentration of

Table 2  Obsidian projectile points found at Kaman-Kalehöyük

<table>
<thead>
<tr>
<th>No</th>
<th>Year</th>
<th>Sector</th>
<th>Grid</th>
<th>PL 1</th>
<th>Source</th>
<th>L 2/mm</th>
<th>W 3/mm</th>
<th>T 4/mm</th>
<th>We 5/g</th>
<th>Retouch</th>
<th>Shape</th>
<th>Section</th>
<th>Stem</th>
<th>etc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2004</td>
<td>XXXIV</td>
<td>XXXI-56</td>
<td>1</td>
<td>NZN</td>
<td>35.46</td>
<td>20.28</td>
<td>6.08</td>
<td>3.9</td>
<td>Edge</td>
<td>?</td>
<td>Triangle</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2004</td>
<td>XXVII</td>
<td>XLVI-53</td>
<td>3</td>
<td>NNZ</td>
<td>31.61</td>
<td>20.28</td>
<td>7.04</td>
<td>2.7</td>
<td>Semi-bifacial</td>
<td>Oval</td>
<td>Semi-Oval</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2006</td>
<td>XXXIV</td>
<td>XXXIII-57</td>
<td>3</td>
<td>KMR</td>
<td>42.12</td>
<td>20.27</td>
<td>6.99</td>
<td>4.8</td>
<td>Semi-bifacial</td>
<td>Oval</td>
<td>Semi-Oval</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1997</td>
<td>XXX</td>
<td>XLVII-51</td>
<td>3</td>
<td>TLC</td>
<td>22.25</td>
<td>13.76</td>
<td>6.8</td>
<td>2.4</td>
<td>Semi-bifacial</td>
<td>?</td>
<td>Semi-Oval</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1995</td>
<td>XXI</td>
<td>XLVII-57</td>
<td>1</td>
<td>NNZ</td>
<td>20.32</td>
<td>21.01</td>
<td>8.78</td>
<td>4.5</td>
<td>Bifacial</td>
<td>?</td>
<td>Oval</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2006</td>
<td>XIII</td>
<td>XL-52</td>
<td>1</td>
<td>KMR</td>
<td>37.31</td>
<td>39.24</td>
<td>12.64</td>
<td>18</td>
<td>Edge</td>
<td>?</td>
<td>Triangle</td>
<td>Yes</td>
<td>Surface cleaning</td>
</tr>
</tbody>
</table>

1: Provisional Layer  2: Length  3: Width  4: Thickness  5: Weight
trace elements in the obsidian. Groups are delineated by plotting two indices against each other in scattergrams. The two most effective combinations of indices for discriminating the sources of tools in this study are:

\[ \text{Rb} \times 100 / (\text{Rb} + \text{Sr} + \text{Y} + \text{Zr}) \] and \[ \text{Mn} \times 100 / \text{Fe} \]

5. RESULTS AND DISCUSSION

Figures 2 and 3 show the results of source discrimination. All obsidian sources in Central and Eastern Turkey can be distinguished by these diagrams. Artefacts analysed in this study also can be assigned to particular sources. Three of them are identified as the Nenezi Dağı obsidian source (NNZ) and two of them are identical to the Kömürcü (Göllü Dağı East) obsidian source (KMR). Although one artefact cannot be distinguished between the Sarıkamış source (SRK1) and Tulece Tepe (TLC) in Figure 2, it is possible to differentiate these two outcrops by Figure 3, and this sample should be identified as TLC.

Though the number of artefacts is relatively small, the majority of utilised obsidian sources for projectile point production seems to be Nenezi Dağı and Göllü Dağı East sources. This tendency is congruent with results obtained from the XRF analysis of debitage from Kaman-Kalehöyük (ibid. 2002; ibid. 1997). This might mean that there is no substantial difference between material acquisition for stone tool manufacturing of formal tools and that of expedient ones. However, we may need to analyse more formal tools because some lithic industries in Central Anatolia are known to be linked with a particular source (ibid. 2006).

In addition, it is worth emphasising the regional importance of Nenezi Dağı and Göllü Dağı East sources. Not only in Kaman-Kalehöyük, but also in adjacent areas and other distant regions, such as Levant or Cyro-Mesopotamia, these two sources had been widely utilised.
Fig. 2 Result of XRF analysis (1)

Fig. 3 Result of XRF analysis (2)
sources since the Neolithic Age (ibid. 2006; Chataigner, Poidevin and Arnaud 1998; Gratuze 1999; ibid. 2001b; Maeda 2000). At both outcrops, stone tool workshops have been confirmed (Balkan-Atlı 1998; Balkan-Atlı and Aprahamian 1998; Balkan-Atlı et al. 2001). Existence of such a workshop should have been a driving force to distribute obsidian to wider areas.

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