

The Origins of The Obsidian Artifacts from Gua Pawon, Dago and Bukit Karsamanik in Bandung, Indonesia

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Abstrak. Tulisan ini membahas hasil studi tentang sumber bahan baku artefak obsidian yang ditemukan di Gua Pawon, Dago, dan Bukit Karsamanik, Bandung. Analisis dilakukan terhadap sejumlah artefak obsidian, temuan ekskavasi di Gua Pawon dan temuan permukaan di Situs Dago dan Bukit Karsamanik. Untuk perbandingan dilakukan juga analisis terhadap obsidian dari Gunung Kendan di Nagrek dan Kampung Rejeng di Garut, dua lokasi sumber obsidian di Jawa Barat.

Analisis dilakukan dengan cara "*scanning electron microscope*", menggunakan "*energy dispersive X-ray spectrometer*" di Universitas Sains Malaysia, Penang dan "*electron microprobe*" di Universitas Malaya, Kuala Lumpur. Analisis multielemen dan perhitungan statistic dilakukan terhadap data yang diperoleh dari artefak dan bahan. Hasil studi memperlihatkan artefak obsidian dari Gua Pawon menggunakan bahan dari Gunung Kendan dan Kampung Rejeng, sementara artefak Dago dan Bukit Karsamanik belum diketahui sumbernya. Analisis terhadap bahan dari sumber-sumber lain sangat diperlukan untuk menentukan variabilitas di dalam dan di antarasumber-sumber yang berbeda. Untuk sementara, hasil studi memperlihatkan manusia prasejarah Gua Pawon mengeksploitasi dan menggunakan sumber-sumber obsidian yang sama selama beberapa ribu tahun.

Kata kunci: analisis obsidian, gua pawon, dago, karsamanik, *scanning electron microscope*, *x-ray spectrometer*.

Abstract. This paper presents the results of a study to determine whether the obsidian artifacts found in Gua Pawon, Dago and Bukit Karsamanik in Bandung came from the well-known sources of Gunung Kendan in Nagreg, Kampung Rejeng in Garut or elsewhere. Obsidian artifacts for this study were obtained from earlier archaeological excavations at Gua Pawon and from chance finds at the sites of Dago and Bukit Karsamanik in Bandung. Samples of obsidian were also collected from the known obsidian sources in Gunung Kendan in Nagreg and Kampung Rejeng in Garut for comparative purposes.

Analyses of these samples were done on a scanning electron microscope using the energy dispersive X-ray spectrometer at the University of Science Malaysia, Penang and the electron microprobe at the University of Malaya, Kuala Lumpur. Multi-element analysis was undertaken, and statistical procedures were performed on data obtained from the artifacts and the sources. The results of the study thus far suggested that the obsidian artifacts from Gua Pawon were made using obsidian obtained from both Gunung Kendan and Kampung Rejeng sources while those from Dago and Bukit Karsamanik have yet to be determined. More samples from all the known obsidian sources are needed to determine the variability within and between all the different sources. Temporally, the study also revealed that prehistoric humans at Gua Pawon exploited or used the same obsidian resources over several thousands of years.

Key words: pawon cave, dago, karsamanik, scanning electron microscope, x-ray spectrometer.

Introduction

Obsidian is a natural volcanic glass, which was widely used during prehistoric times as cutting implements probably because it is shiny and attractive, and can be worked easily into implements with razor sharp edges. Obsidian is formed through relatively fast cooling of high-silica lava domes and flows that are usually very homogeneous in chemical composition. The geological occurrence of obsidian is typically very limited and its homogeneous chemical composition is often highly characteristic of a particular source. Its relatively limited occurrences have also made it a valuable item of trade or exchange during prehistoric times. Although obsidian artifacts are brittle and have a short use-life, they are highly durable and can be found in archaeological sites over thousands of years. As such, obsidian serves as an excellent material for studies in prehistoric sourcing, trade or exchange.

In the last 30 years or so, research in the Mediterranean, the southwest Pacific and Southeast Asia have produced successful results using obsidian sourcing to extract information on prehistoric trade and exchange. This is mainly because linking obsidian artifacts to its geographical sources can be successfully done using a wide range of techniques such as the X-ray fluorescence analysis, the electron microprobe analysis, the neutron activation analysis, the proton-induced gamma-ray emission method and the proton-induced X-ray emission method (Ward 1973, Smith *et al.* 1977, Ambrose *et al.* 1981, Bird *et al.* 1981, Duerden *et al.* 1987, Green 1987, Green & Bird 1989, Bellwood & Koon 1989, Williams-Thorpe 1995, Tykot 1996, Shackley 1998, Chia 2003, 2003a).

The islands of Indonesia, which possess active volcanic island arcs associated with explosive volcanism have produced many obsidian sources, and some of these sources have been exploited and used by pre-

historic humans to make obsidian tools such as those in found in the Bandung region. However, many of the obsidian artifacts have yet to be chemically traced to the known sources. This study is an attempt to trace the obsidian artifacts found at the sites of Gua Pawon, Dago and Bukit Karsamanik in Bandung to some of the nearby and known sources in Nagreg and Garut.

Obsidian Artifacts in Bandung

Obsidian artifacts have been discovered from a number of areas in the Bandung Basin such as Padalarang, Pakar (Southwest of Dago), Dago (KQ 380), north of Pasir Soang, Pasir Cikebi, west of mount Tugu 2, northwest of Pasir Layung 2, south of mount Cimenyan, Pasir Panyandakan (KQ 273), mount Jatiluhur, Sekebunar, Cingiringsing, Pasir Luhur, west of mount Cinangka area, and northwest of Pasir Pongkor, Lembang, Cicalengka, Banjaran, Soreang, Cililin, Bukit Karsamanik and Gua Pawon (Figure 1).

The discovery of these obsidian artifacts have been reported by de Jong and von Koenigswald (1930), Krebs (1932-1933), Mohler and Rothpletz (1942-1945), van Stein Callenfels (1934), van der Hoop (1938), von Heine Geldern (1945), Bandi (1951), van Heekeren (1972), Nies Anggraeni (1978), Pantjawati (1988), Nurul Laili (2005), and Lutfi Yondri (2005). The precise dating of the obsidian artifacts found in these sites, however, remains mostly unknown due the lack of chronometric dates. Nonetheless, earlier researchers such as von Koenigswald and van der Hoop had classified these obsidian artifacts as implements dating to the Neolithic (cultivation) period based on the existence of pottery, square hatchet fragment, and metal printing; moulds (Callenfels, 1934, Koeningswald, 1935, Hoop, 1940, Soejono, 1984). Others such as von Heine Geldern (1945), Bandi (1951), and Soejono (1984), however, preferred to classify the obsidian artifacts as artifacts from the older hunting and gathering period.

Gua Pawon

Gua Pawon (Pawon Cave) is located in the Cipatat district in the western plateau of the Bandung Basin area (Figure 1). This cave is situated approximately 716 meters above sea level in Mount Masigit, which is part of the Rajamandala limestone formation, consisting of mostly a bunch of limestone and laminated limestone with content of foraminifera (Sudjatmiko 1972). The Bandung Archaeological Research Bureau in cooperation with the Board of Archaeological Heritage, History, and Traditional Values of West Java Province carried out six seasons of excavations in Gua Pawon in July and October

2003, May 2004, and also April 2004. The excavations revealed a wide variety of artifacts such as obsidians tools, bone tools, fragments of animal bones, mollusks remains, and human burials. A considerable amount of obsidian artifacts and wastes were found in Gua Pawon during the excavations. Most of the obsidian artifacts were found at depths of between 20 cm and 60 cm. The association of the other cultural artifacts with the obsidian artifacts and the radiocarbon dating of associated charcoal and bone samples placed the obsidian artifacts to date between 5,600 BP and 9,500 BP (Yondri 2004, 2005).

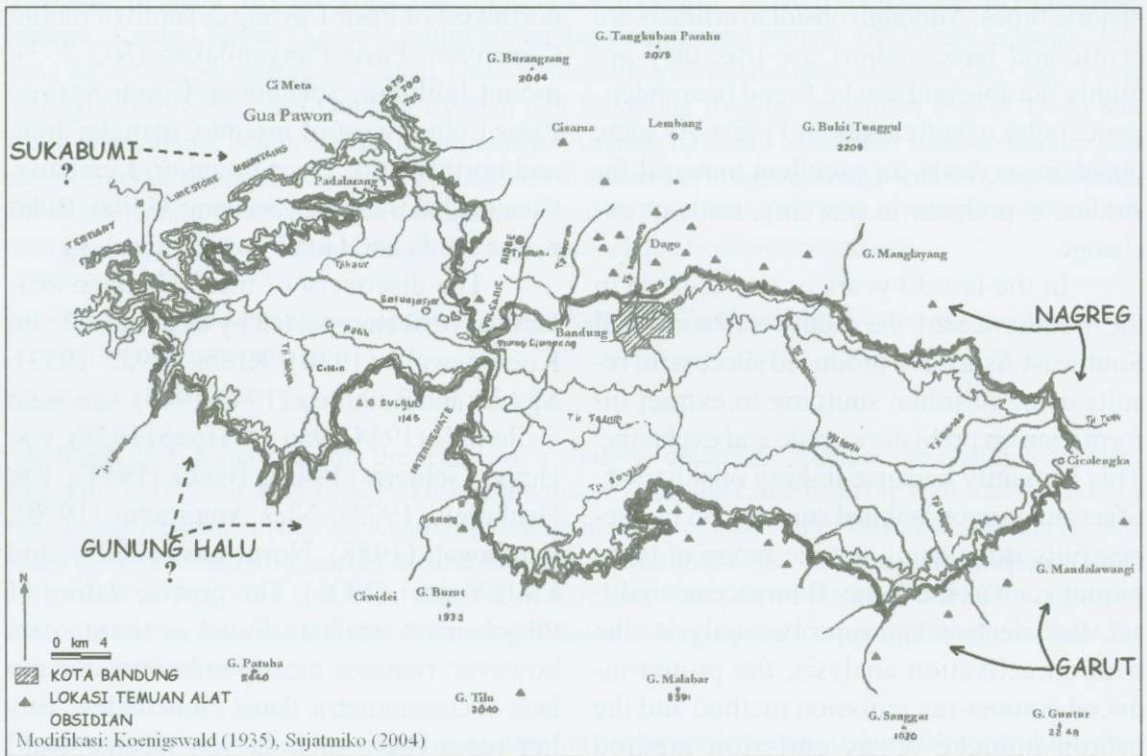


Figure 1. Distribution of obsidian artifacts and sources found in the Bandung Basin area

Dago and Bukit Karsamanik

Dago lies to the north of the Bandung basin area and Bandung town. It is situated about 723 meters above sea level. The potential of Dago as a significant archaeological site is suggested by the discovery of a variety of artifacts from different cultural

periods such as Paleolithic stone implements, obsidian, pottery and metal artifacts. Local villagers often report finding obsidian artifacts in Dago during farming or the construction of school or housing estate.

Bukit Karsamanik is located in the east of Bandung, near Mount Manglayang. Admin-

istratively this area is included in the district of Cileunyi, a sub-province of Bandung. Bukit Karsamanik lies about 720 meters above sea level. At present, the area surrounding Bukit Karsamanik is a non-irrigated dry field and is also a new region for housing development. Obsidian artifacts are usually found in this area during farming and land tilling.

Obsidian Sources in Bandung

Obsidian sources known in the Bandung region include Gunung Halu, Gunung Kendan (Nagreg), Gunung Kiamis and Kampung Rejeng (Garut), and Jampang (Sukabumi). Gunung Kendan is located near the Bandung Basin area while Gunung Halu is situated about 10 km to the west of Bandung. Kampung Rejeng and Gunung Kiamis are located about 100 km away east of Bandung, and Jampang about 70 km southwest of Bandung (Figure 1).

Field visits were made to the known obsidian sources in Bandung and Nagreg with the help of volcanologist, Dr. Indyo Pratomo, and geologist Drs. Ayeng Hikmat from the Geological Museum in Bandung to collect obsidian samples for the study. Two major obsidian sources, namely Gunung Kendan in Nagreg and Kampung Rejeng near Kawah Drajat, Garut, located more than 100km away from Bandung were visited. Both Gunung Kendan and Kampung Rejeng were found to be large obsidian outcrops, which are still quarried by the local Sunda people who sell the obsidian rocks to ceramic producers. Samples of obsidian were collected from both these major source areas and chemical analyses of these obsidian samples were carried out in order to see if they match any of the obsidian artifacts found in Gua Pawon, Dago and Bukit Karsamanik.

The Obsidian Samples and Analyses

A total of 26 obsidian samples were used in this study - comprising 21 pieces of obsidian artifacts and 5 obsidian source

samples. Of the 21 pieces of obsidian artifacts, 12 pieces were selected from the excavated site of Gua Pawon conducted by Lutfi Yondri while 5 pieces were chance finds from Dago and another 4 pieces were chance finds from Bukit Karsamanik, provided by Truman Simantunjak. The 5 pieces of obsidian samples collected from the source areas used in this study comprised 3 samples from Gunung Kendan, Nagreg and 2 samples from Kampung Rejeng at Kawah Drajat, Garut.

The 12 obsidian samples from Gua Pawon were selected from obsidian artifacts excavated from the undisturbed spits 1 to 14 (160 cm), radiocarbon dated between 5,600 and 9,500 BP (Yondri 2005). Obsidian artifacts with different visible characteristics such as colour, translucency, lustre, and texture, that might indicate different sources, were selected. This is also done in order to reduce sample bias toward selecting obsidian pieces produced from a single piece of core or a single source.

The majority of the samples were analyzed using the Scanning Electron Microscope (Model JEOL JSM-6460LV) equipped with Oxford INCA Energy 200 Energy Dispersive X-ray Spectrometer at the University of Science Malaysia in Penang. Some of the samples were also analysed using the Cameca MBX Electron Microprobe using wavelength dispersive spectrometers at the University of Malaya, Kuala Lumpur. Both these methods were chosen as the methods of choice mainly because they are minimally destructive (only 1 mm size sample is needed) and are relatively fast and accurate methods for determining the selected range of elements within the required detection limits, depending upon the element and composition of the sample. The range of elements that were detectable and selected included Si, Al, Fe, Ca, K, Na and O. These are among some of the most useful elements for distinguishing the known obsidian sources in Southeast Asia.

Discussion and Conclusion

Statistical examination of the elemental data revealed that the obsidian artifacts from Gua Pawon, Dago and Bukit Karsamanik each formed their own groups. The Dago and Bukit Karsamanik samples formed distinct groups but they tend to overlap each other while the Gua Pawon samples are more dispersed or scattered (Figures 2,3, & 4). The samples from Gua Pawon, however, appeared to fall within both the two known obsidian sources – Gunung Kendan in Nagreg and Kampung Rejeng in Garut. Both these sources also showed closely similar chemical compositions that are not distinguishable using the current set of elements (Table 1). A finer elemental discrimination perhaps using other trace elements can help to distinguish these two sources. Since so few source samples were used in this study, there is also a need for larger samples from these two sources and the other known source localities (especially Jampang, Gunung Halu and Kiamis) in order to understand better the nature and degree of variability within and between the different sources. At present, the data suggests that the obsidian artifacts from Gua Pawon could possibly come from Nagreg or Garut or both these sources.

The samples from Dago and Bukit Karsamanik, on the other hand, tend to overlap each other (Figures 2,3 & 4), suggesting that they came from the same source(s). Both the Dago and Karsamanik samples, however, do not seemed to fall within the two known obsidian sources of Gunung Kendan in Nagreg and Kampung Rejeng in Garut, suggesting that they were probably derived from other obsidian source(s). Again, more samples from these two known obsidian sources are needed to determine the variability within and between the obsidian sources in order to eliminate the possibility that the Dago and Bukit Karsamanik samples came from these two known sources.

Temporally, the elemental data of the obsidian artifacts from Gua Pawon, which were sampled from different stratigraphical levels, were closely similar and they tend to group together in the statistical examination (Figures 2,3 & 4), suggesting that they were derived from the same source or similar sources over several thousands of years.

In conclusion, the results of the study suggested that the obsidian artifacts from Gua Pawon were made using obsidian obtained possibly from both the known obsidian sources of Gunung Kendan in Nagreg and Kampung Rejeng in Garut while those from the sites of Dago and Bukit Karsamanik have yet to be determined. The Gunung Kendan and Kampung Rejeng sources were chemically very similar and therefore could not be distinguished chemically at the moment. A finer discrimination using trace elements is recommended. In addition, more samples from these two sources and the other known sources of Jampang, Gunung Halu and Kiamis are needed in order to determine the variability within and between these different sources. The study also indicated that pre-historic humans at Gua Pawon exploited or used the same obsidian resources over several thousands of years.

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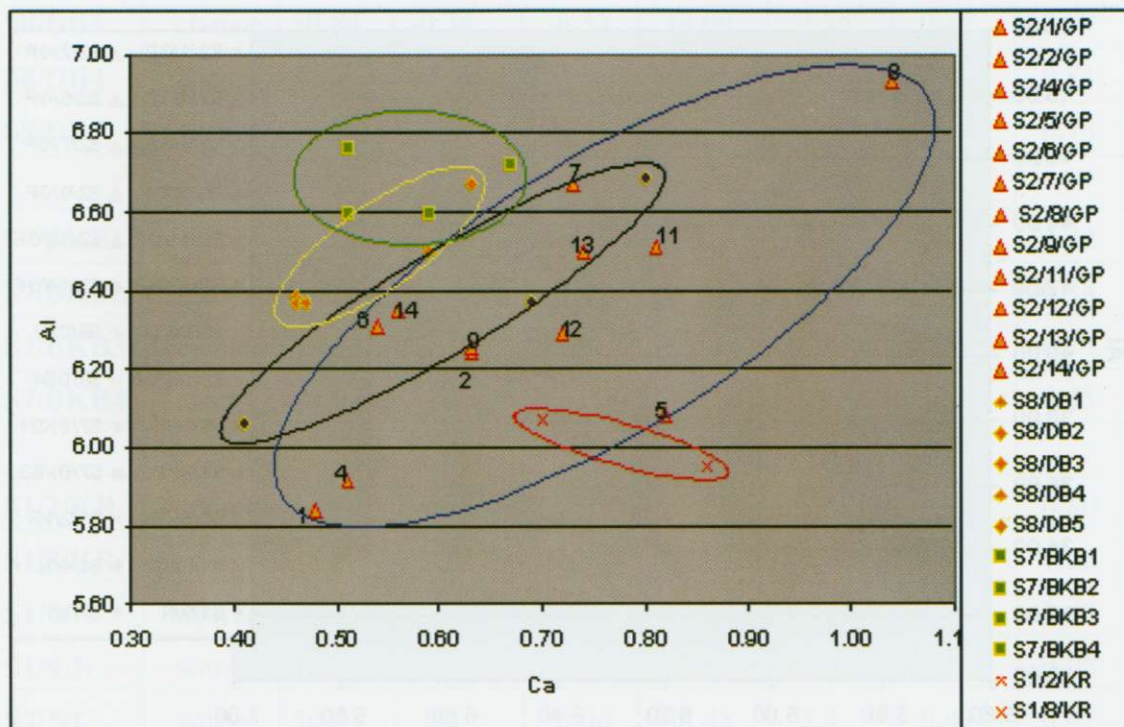


Figure 2 Bivariate plot of Al versus Ca

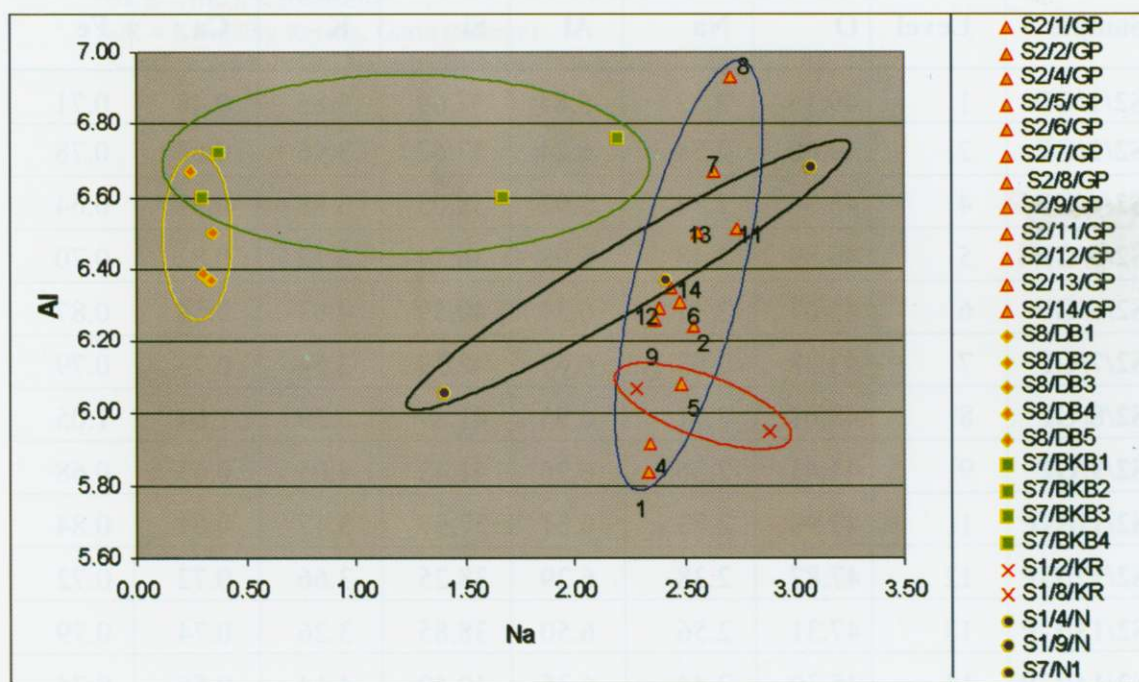


Figure 3 Bivariate plot of Al versus Na

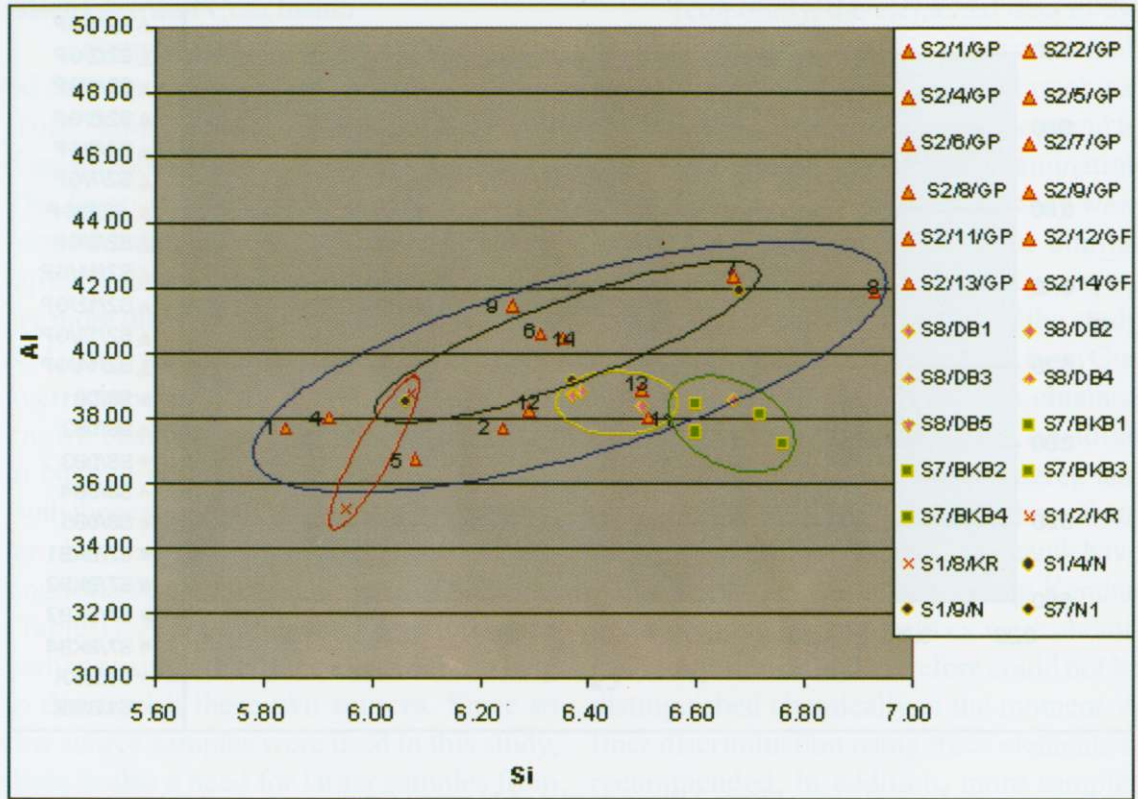


Figure 4 Bivariate plot of Al versus Si

Sample	Level	O	Na	Al	Si	K	Ca	Fe
S2/1/GP	1	49.13	2.33	5.84	37.69	3.85	0.48	0.71
S2/2/GP	2	49.00	2.54	6.24	37.67	3.16	0.63	0.78
S2/4/GP	4	48.38	2.34	5.92	38.03	3.88	0.51	0.64
S2/5/GP	5	46.89	2.48	6.08	36.74	3.12	0.82	0.70
S2/6/GP	6	45.07	2.47	6.31	40.59	4.03	0.54	0.87
S2/7/GP	7	43.28	2.63	6.67	42.39	3.54	0.73	0.79
S2/8/GP	8	43.01	2.71	6.93	41.89	3.39	1.04	1.05
S2/9/GP	9	44.45	2.36	6.26	41.43	4.05	0.63	0.68
S2/11/GP	11	47.99	2.73	6.51	37.97	3.17	0.81	0.84
S2/12/GP	12	47.87	2.38	6.29	38.25	3.66	0.72	0.72
S2/13/GP	13	47.31	2.56	6.50	38.85	3.26	0.74	0.79
S2/14/GP	14	45.30	2.44	6.35	40.49	4.14	0.56	0.74
S8/DB1	chance	50.93	0.3	6.39	38.8	0.25	0.46	0.76
S8/DB2	chance	50.88	0.33	6.37	38.74	2.37	0.46	0.7

S8/DB3	chance	50.84	0.34	6.37	38.69	2.35	0.47	0.79
S8/DB4	chance	50.71	0.35	6.5	38.37	2.44	0.59	0.83
S8/DB5	chance	50.94	0.24	6.67	38.56	2.04	0.63	0.73
S7/BKB1	chance	50.24	1.67	6.6	37.56	2.82	0.51	0.42
S7/BKB2	chance	50.13	2.19	6.76	37.23	2.66	0.51	0.38
S7/BKB3	chance	50.81	0.3	6.6	38.45	2.33	0.59	0.74
S7/BKB4	chance	50.67	0.37	6.72	38.14	2.36	0.67	0.85
S1/2/KR	source	47.22	2.28	6.07	38.71	3.94	0.70	0.80
S1/8/KR	source	48.95	2.88	5.95	35.22	2.43	0.86	1.26
S1/4/N	source	43.05	3.07	6.68	41.93	2.99	0.80	1.49
S1/9/N	source	46.34	2.41	6.37	39.14	3.91	0.69	0.98
S7/N1	source	50.61	1.4	6.06	38.48	2.4	0.41	0.47

Table 1 Elemental Data of Obsidian Samples

Note: GP = Gua Pawon
 DB = Dago
 BKB = Bukit Karsamanik
 KR = Kampung Rejeng, Garut (Source)
 N = Gunung Kendan, Nagreg (Source)

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