

Application of in-situ produced terrestrial cosmogenic nuclides to archaeology: A case study from Cuba

Akçar, N., *Müller-Beck, H., **Ivy-Ochs, S., ***Kubik, P.W. & Schlüchter, C.

University of Berne, Institute of Geological Sciences, Baltzerstrasse 1-3, 3012 Bern, Switzerland, akcar@geo.unibe.ch, schluech@geo.unibe.ch

*Professor Emeritus, University of Tübingen, Sulgenauweg 38, 3007 Bern, Switzerland, hansjuergen.mueller-beck@uni-tuebingen.de

**Institute of Particle Physics, ETH Hönggerberg, 8093 Zürich, Switzerland, ivy@phys.ethz.ch

***Paul Scherrer Institute c/o Institute of Particle Physics, ETH Hönggerberg, 8093 Zürich, Switzerland, kubik@phys.ethz.ch

During prehistory, stone artifacts have been widely used until the Bronze Age. Due to its unique fracture properties, most of the stone artifacts are produced from flint, which is a microcrystalline form of quartz (Verri et al. 2005). The application of in situ produced terrestrial cosmogenic nuclides (TCN) to the flint artifacts can provide information on the production time, manner and even the complex exposure and burial histories of the individual artifacts. For this application, at least two TCNs, such as ^{10}Be and ^{26}Al , have to be analyzed by Atomic Mass Spectrometry. Although TCN were successfully applied to stone artifacts from Egypt (Ivy-Ochs et al. 2001) and flints from Israel (e.g. Verri et al. 2004; 2005), ^{10}Be was the only TCN that could be measured in these studies.

Who first arrived in the Americas? When, where and how? Scientists have long debated on these questions. Actually, the Clovis culture has long been assumed as the direct ancestor of the Native Americans, i.e. the first people entering the new World, around 13,500 years ago at the end of the last ice age. Many Archaeologists have long debated the possible existence of a culture older than Clovis in North and South America. Recently new findings from North America and Cuba supported the presence of pre-Clovis culture or even cultures during the Last Ice Age (Dillehay 2003).

Can these new findings tell us anything more about when the first humans arrived in the Americas? With the aim of answering this question, in this study, four different flint artifacts from archaeological sites in Seboruco (Fig. 1) and La Chuchita (Fig. 2), in Cuba, were treated for AMS analysis of ^{10}Be and ^{26}Al . Modified chemical and physical procedures were followed to extract ^{10}Be and ^{26}Al , in order to reach the suitable ^{27}Al levels required for a successful AMS measurement ($^{27}\text{Al} < 100$ ppm). ^{10}Be measurements of the samples were successfully completed, and ^{26}Al measurements are still to be completed. The detailed interpretation of the results will be done after gathering the ^{26}Al results.

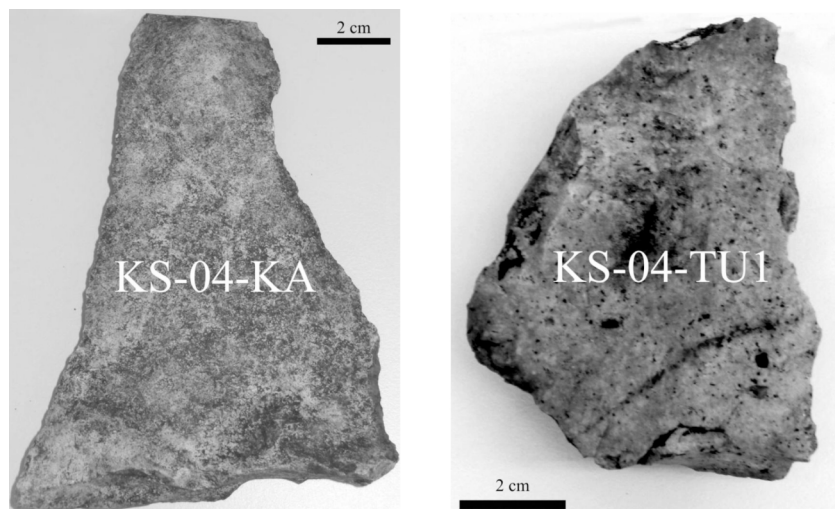


Figure 1. Photographs of the stone artifacts from Seboruco.

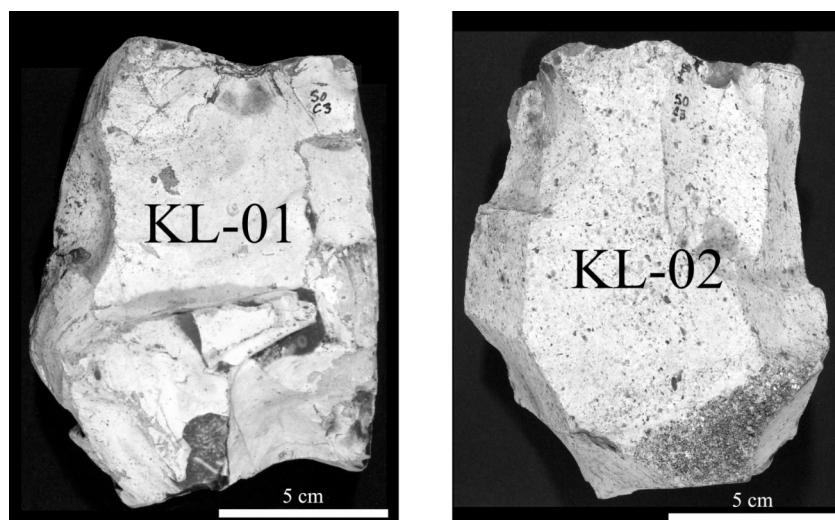


Figure 2. Photographs of the stone artifacts from La Chuchita.

REFERENCES

- Dillehay, T.D. (2003): Palaeoanthropology: Tracking the first Americans. *Nature* 425 (6953): 23-24
- Ivy-Ochs, S., Wüst, R., Kubik, P.W., Müller-Beck, H., & Schlüchter, C. (2001): Can we use cosmogenic isotopes to date stone artifacts? In: Proceedings of the 17th international radiocarbon conference (Ed. by Carmi, I., & Boaretto, E.). *Radiocarbon* 43 (2B): 759-764.
- Verri, G., Barkai, R., Gopher, A., Hass, M., Kubik, P.W., Paul, M., Ronen, A., Weiner, S., & Boaretto, E. (2005): Flint procurement strategies in the Late Lower Palaeolithic recorded by in situ produced cosmogenic Be-10 in Tabun and Qesem Caves (Israel). *Journal of Archaeological Science* 32 (2): 207-213.
- Verri, G., Barkai, R., Bordeanu, C., Gopher, A., Hass, M., Kaufman, A., Kubik, P.W., Montanari, E., Paul, M., Ronen, A., Weiner, S., & Boaretto, E. (2004): Flint mining in prehistory recorded by in situ-produced cosmogenic ¹⁰Be. *PNAS* 101 (21): 7880-7884.