

Search for Q: single grain Xe isotope analyses of graphitic residue from Yilmia (EL6)

A. B. VERCHOVSKY¹, J. D. GILMOUR², G. HOLLAND²,
AND I.P. WRIGHT¹

¹Open University, Milton Keynes, UK.

(a.verchovsky@open.ac.uk)

²University of Manchester, Manchester, UK.

(jgilmour@fs1.ge.man.ac.uk)

The nature of phase Q, the carrier of one of the major noble gas component in the Solar System [1] remains uncertain. All attempts to isolate it by physical methods have failed [1-3]. Recently we have shown that being carbonaceous in nature, the carrier is nonetheless distinct from the majority of carbon matter present in meteorites in its chemical properties. In particular it is not graphitised under reducing conditions in enstatite chondrite parent bodies: significantly different combustion temperatures for Q and majority of graphitic carbon in Yilmia (EL6) was observed [4]. However even in this, seemingly favourable case, Q cannot be physically separated from the majority of graphitic material present in the meteorite. This presumably indicates that Q is somehow closely physically associated with graphitic grains.

In order to understand how the different phases are related to each other we decided to analyse single carbonaceous grains from Yilmia HF-HCl residue for Xe using the high sensitivity RELAX instrument [5]. Most of the grains were analysed using Raman spectroscopy in order to identify carbonaceous grains and characterise their structural features.

Only 20 out of more than 200 grains analysed yielded Xe above (factor of 2-4) the procedural blank level ($1-1.5 \cdot 10^{-16}$ cc ^{132}Xe). The concentration of Xe in the grain with highest measured yield is about 10^{-7} cc/g which is almost two orders of magnitude less than expected for Q. Moreover, the concentration of Xe measured in all the grains we analysed is less than 10^{-9} cc/g – again almost two orders of magnitude less than in the bulk sample.

The obtained results clearly indicate that Q is not equally associated with all carbon grains. The association is not adsorption of gas on the grains nor “adsorption” of small Q-grains on larger graphite grains. Thus, we have to conclude that the relationship between Q and other carbonaceous grains is quite specifically related to the, so far unknown, properties of Q, so that only some rare particular graphitic grains are involved in the relationship.

References

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^{10}Be measurements on Neolithic and Paleolithic flint tools from Israel

G. VERRI¹, R. BARKAI², Y. BEN-DOV³, E. BOARETTO⁴,
C. BORDEANU⁵, A. GOPHER², M. HASS⁵, M. PAUL¹ AND
S.WEINER⁶,

¹Racah Institute of Physics, Hebrew University of Jerusalem, Jerusalem, Israel (verri@phys.huji.ac.il)

²Inst. of Archeology, Tel Aviv University, Tel Aviv, Israel (agopher@post.tau.ac.il, barkaran@post.tau.ac.il)

³NRC, Soreq, Israel (bendov@soreq.gov.il)

⁴ESER Dept., Weizmann Institute of Science, Rehovot, Israel (elisa@wisemail.weizmann.ac.il)

⁵Particle Physics Dept., Weizmann Institute of Science, Rehovot, Israel (michael.hass@weizmann.ac.il, bordeanu@clever.weizmann.ac.il)

⁶Structural Biology Dept., Weizmann Institute of Science, Rehovot, Israel (Steve.Weiner@weizmann.ac.il)

The analysis of the ^{10}Be content of prehistoric flint tools could help in the understanding of cultural and technological issues connected to the mining of chert in the Neolithic and Paleolithic. Since the quality of the raw material (chert) is important in flint knapping, the study of the development of mining is of much interest. The determination of the presence of the cosmogenic isotope ^{10}Be (half-life = 1.5 million years) in flint samples can be used to address this problem. Radioactive ^{10}Be is a cosmogenic nuclide that is produced *in situ* in mineral crystals. The presence of ^{10}Be in prehistoric flint tools would indicate the use of surface materials as opposed to mined materials. In a control study of mined flint in Ramat Tamar, a Neolithic mining site in the Negev desert (Israel), the comparison of ancient tools, buried and exposed chert nodules allowed us to confirm this hypothesis. The ^{10}Be concentration, measured by accelerator mass spectrometry (AMS), shows that the buried nodules and the flint worked fragments have much less ^{10}Be than flints exposed on the surface. The average amount of ^{10}Be per gram of initial flint for tools and buried nodules is about 0.2×10^6 ^{10}Be atoms per gram of initial material. This is consistent with the flint tools having been formed from mined raw materials. The exposed flints display a wide variation: $1.7-4.0 \times 10^6$ ^{10}Be atoms/g of initial material, indicating maybe different exposure and erosion histories at the surface. One exposed flint overlaps completely with unexposed nodules; it was presumably exposed for a relatively short period. The same approach is being applied to archaeological samples coming from two Paleolithic caves in the north of Israel. The novelty of this application of ^{10}Be detection and the important cultural aspects of tool fabrication, make this research fascinating. Hopefully it will contribute to our understanding of a part of human history where scientific data are rare and difficult to obtain.