Continued Search for Supernova Produced ^{60}Fe Activity on Earth

A. Arazi, T. Faestermann, J. Fernandez Niello [a], W. Hillebrandt [b], K. Knie, G. Korschinek, G. Rugel, U. von Stackelberg [c], A. Wallner, and C. Wallner

[a] Laboratorio TANDAR CNEA, Buenos Aires, Argentina [b] Max-Planck-Institut für Astrophysik
[c] Bundesanstalt für Geowissenschaften und Rohstoffforschung, Hannover

If in the past a Supernova (SN) had exploded in the vicinity of the sun (within some 100 light years), we would expect that some of the ejecta would be deposited on earth. In case these nuclides are radioactive and not produced in similar quantities within the solar system, we might be able to detect such SN deposits on earth. With our extremely sensitive AMS method using a gas filled magnet to distinguish isobaric ions we are investigating deep ocean ferromanganese crust for long lived radioisotopes. Ferromanganese crusts are very slowly accreting ions from the sea water (2-5mm per Myr) and thus show the long term record of extraterrestrial material which has entered the ocean. As the most promising nuclide to search for ^{60}Fe was chosen for the following reasons:

- ^{60}Fe is thought to be ejected by a SN in large quantities,
- its half life of 1.5 Myr is in the order of the expansion time of a SN shell,
- its production by the cosmic radiation in meteoritic or atmospheric material is extremely low and
- a most sensitive detection is possible, since only the second next isobaric and isotopic neighbours are stable.

In a crust from a depth of 1300 m in the South Pacific we had found a ^{60}Fe concentration exceeding that estimated for the production within the solar system by a large margin [1,2]. We found also an indication that the deposition in a time span between 3 and 6 Myr was higher than before and after that period. But the statistical significance of these findings was not very high and the dating of the depth profile in that crust was obtained from the cobalt concentration, a method considered not too certain.

During the past two years we have analyzed another ferromanganese crust with the identification VA13/2 which has been recovered 1976 in the Central Pacific from a depth of 4830 m. Its depth profile has been dated via the isotopic ratio ^{10}Be/^{9}Be [3]. ^{10}Be with its half life of 1.5 Myr is very well suited for the time range in question and the growth rate is in the range between 2 and 5 mm/Myr. In order to obtain a fine depth resolution material from the crust was machined off and collected in steps of 2 mm (1mm at the surface) corresponding to time intervals of less than 1 Myr. The deepest sample comes from 43 mm. With a specific chemistry iron was extracted from all the samples (Fig. 1) while avoiding nickel which contains the isobaric ^{60}Ni. In a number of long measuring times the ^{60}Fe/Fe isotopic ratio in these samples was repeatedly measured using our gas filled magnet system. In most of these samples we reached a value of few times 10^{-16} (never obtained in AMS measurements of heavy isotopes before), which seems to be a background level. But about 3 Myr ago we see a significantly higher level of ^{60}Fe, fully in agreement with our earlier measurement on a different crust.

Fig. 1: The extraction chemistry of course has to be done for every sample. The beakers are labelled with the corresponding depth range.

References

[1] K. Knie *et al.*, Phys. Rev. Lett. **83** (1999) 18
[2] T. Faestermann etal, Jahresbericht 1998, p. 44
[3] M. Segl *et al.*, Nature **309** (1984) 540