SEARCHING FOR CONTEMPORARY SUPERNOVA DUST IN DEEP-SEA SEDIMENTS R. C. Ogliore[1], M. Cohen[1], K. Wang[2], H. Chen[2], N. Liu[1]. [1]Department of Physics, Washington University in St. Louis, St. Louis, MO 63130, USA, [2]Department of Earth and Planetary Sciences, Washington University in St. Louis, St. Louis, MO 63130, USA.

Introduction: Excess ^{60}Fe measured in ferromanganese deep-sea crusts [1] was interpreted as a signature of dust from a nearby supernova because ^{60}Fe ($t_{1/2}$ = 2.6 Myr) is not produced efficiently by other mechanisms (e.g. cosmic-ray spallation). The ^{60}Fe excess (^{60}Fe/Fe=1–10 $\times 10^{-15}$) was recently found to be global and present in two different epochs (1.7–3.2 and 6.5–8.7 Myr ago) [2, 3]. Additionally, measurements of ^{60}Fe well above background (^{60}Fe/Fe=3.6$\times 10^{-15}$) in Apollo 12 soils [4] provide strong evidence that supernova grains arrived at the Earth-Moon system $\sim$2 Myr ago. The likely origin of these grains are supernovae from $\sim$9M$_\odot$ stars within a moving group, whose surviving members are now in the Scorpius–Centaurus stellar association (90–100 parsecs from the Sun) [5].

The solar wind and interplanetary magnetic field would have effectively shielded the Solar System from gas and plasma ejected from a nearby supernova, so it was likely supernova dust grains that carried the ^{60}Fe signature to Earth and Moon [6]. Most of this dust likely vaporized upon atmospheric entry [6]. However, if any supernova dust survived, it would represent an extremely valuable sample of contemporary supernova dust that can be compared with well-studied presolar (>4.6 Gyr old) supernova dust [7].

If supernova grains impacting the Moon had very high speed, the vaporized impactor material would exceed the Moon's escape velocity and be lost to space. However, [4] measured a similar concentration of ^{60}Fe as that seen on Earth [2]. Conservatively, the speed of the impacting grain must have been lower than about 10 km/s to account for the measured ^{60}Fe in lunar soils. The peak atmospheric heating temperature of such a grain can be calculated [8]. Grains less than 2 μm will not be heated above 1500° C. Therefore, refractory supernova grains, such as SiC (2730° C) and graphite ($\sim$4000° C) should easily survive atmospheric entry and can likely be found intact within $\sim$2-Myr-old deep-sea sediments.

The concentration of 1 μm contemporary SiC and graphite supernova grains in 2-Myr-old deep-sea sediments can be calculated by using the ^{60}Fe/Fe measurements of [2], the estimated ^{60}Fe/Fe in freshly synthesized supernova material [9], the atom fraction of Fe in presolar supernova grains, the fraction of presolar supernova grains that are SiC, and other considerations. Again using conservative estimates, we estimate there are 50–500 1-μm contemporary supernova SiC grains per 100 g of 2-Myr-old deep-sea sediment. This is similar to the concentration of presolar supernova grains in the sediments, hosted by micrometeorites. However, it would be possible to distinguish contemporary supernova dust from ancient dust by the presence of freshly synthesize, live ^{26}Al ($t_{1/2} = 705,000$ years) in contemporary dust.

Here we describe our effort to identify contemporary supernova grains in deep-sea sediments. Previous efforts to search for corundum, hibonite, and spinel among grains filtered from an ice core from the Qinghai-Tibetan plateau in China yielded no positivie identifications [10], though this study focused on more recent time periods (2–72 kyr ago).

Methods: We were allocated 200 grams of deep-sea sediments from the Antarctic Marine Geology Research Facility. These sediments were collected by the ELTANIN expeditions, sampled from cores measured by [2] and at similar depths: E49-53 ($\sim$385 cm depth) and E45-21 ($\sim$753 cm). The sediments resembled dried mud macroscopically. Backscattered electron imaging (Figure 1) and EDX of the soils revealed they were primarily composed of calcium carbonate in the form of calcareous fossils like coccoliths (several μm in size). Cosmic spherules and barite (released by calcareous microorganisms [9]) are also present in the sediments.

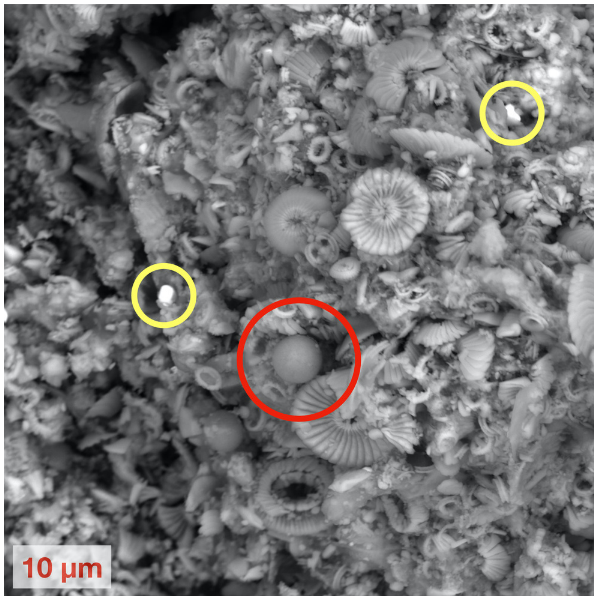

Figure 1: Backscattered electron image of sea sediment showing barite (circled in yellow) and a cosmic spherule (circled in red) embedded in calcareous fossils.