COSMIC SPHERULES IN GLACIOGENIC SEDIMENTS: AN UPDATE. A.E. Funk[1], M.B. Ricke[1], L.B. Wallin[1], J.O. Annexstad[1], and K. Wirth[2]; [1]Dept. of Geology, Bemidji State University, Bemidji, MN 56601-2699, USA, [2]Dept. of Geology, Macalester College, St. Paul, MN 55105, USA.

Cosmic spherules are small particles that melt upon atmospheric entry and resolidify as spherical grains. These spherules offer a less biased study source of asteroidal and cometary material than larger specimens normally studied. With an annual infall rate on the earth $>1/m^2$, they contribute substantially to the yearly cosmogenic influx of material [1]. Spherules have been found incorporated within beach sand [2], in deep-sea sediments [3], South Pole water samples [4], and even in rainwater collection barrels [5]. These particles can also be concentrated by glacial processes such as those seen in Greenland where glacial meltwater concentrates cosmogenic material in supraglacial lakes [6]. Glacial ice also functions as a rafting mechanism for material that settles on the glacier's surface and subsequently becomes incorporated into the ice. In the Antarctic, meteorites carried on top of and within the ice sheet are found concentrated along mountain fronts where deep ice is forced to the surface, ablates away and exposes the specimens [7]. In an attempt to broaden the search for cosmic spherules it was suggested that glacio-lacustrine deposits in the Leech Lake area of northern Minnesota might prove to be an untapped source [8].

The surficial geology of the Leech Lake area of northern Minnesota [9] is attributable to the Wisconsinan glaciation. This area is dominated by deposition from the Rainy Lobe, which came from the northeast, and the Itasca and Wadena Lobes, which entered the area from the northwest. Melt water from these lobes acted as a sorting mechanism for material carried by the ice sheet. Areas such as stream beds, sandars, lacustrine strandlines and deltaic deposits are sites considered favorable for cosmic spherule concentration.

Sediment samples taken from areas as described are plotted on a base map with the aid of a Global Positioning Satellite system. Each sample is numbered and dated, and characteristics of the sediments and site, such as sample color, grain size, depth to sample, and probable lobe of origin, are noted. Sample material is then examined in the laboratory by binocular microscopy for nonterrestrial particles as characterized by sphericity, color, and luster. The suspect particles are separated from other materials, such as pollen grains and clay particles, and sent to Macalester College in St. Paul, Minnesota for further examination by electron microscopy.

Past SEM results have been tantalizing because a high concentration of magnetite in many of the spherules from the Leech Lake area had been previously reported [10]. The particles generally range from seventy-five to one hundred microns in diameter with spherical morphologies similar to confirmed cosmic spherules. Analysis of the grains by energy dispersive spectrometry (SEM-ED) indicate that most of the grains are rich in SiO_2 (50-60 wt %), Al_2O_3 (5-25 wt %), FeO (10-20 wt %), MgO (2-4 wt %), and CaO (0.5-2.0 wt %). However, many particles show some alteration as evidenced by the formation of iron oxides and clay.

Although our labors have not yielded large numbers of specimens, we are sufficiently encouraged to continue the project as an excellent undergraduate learning experience [11]. The search goes on.

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