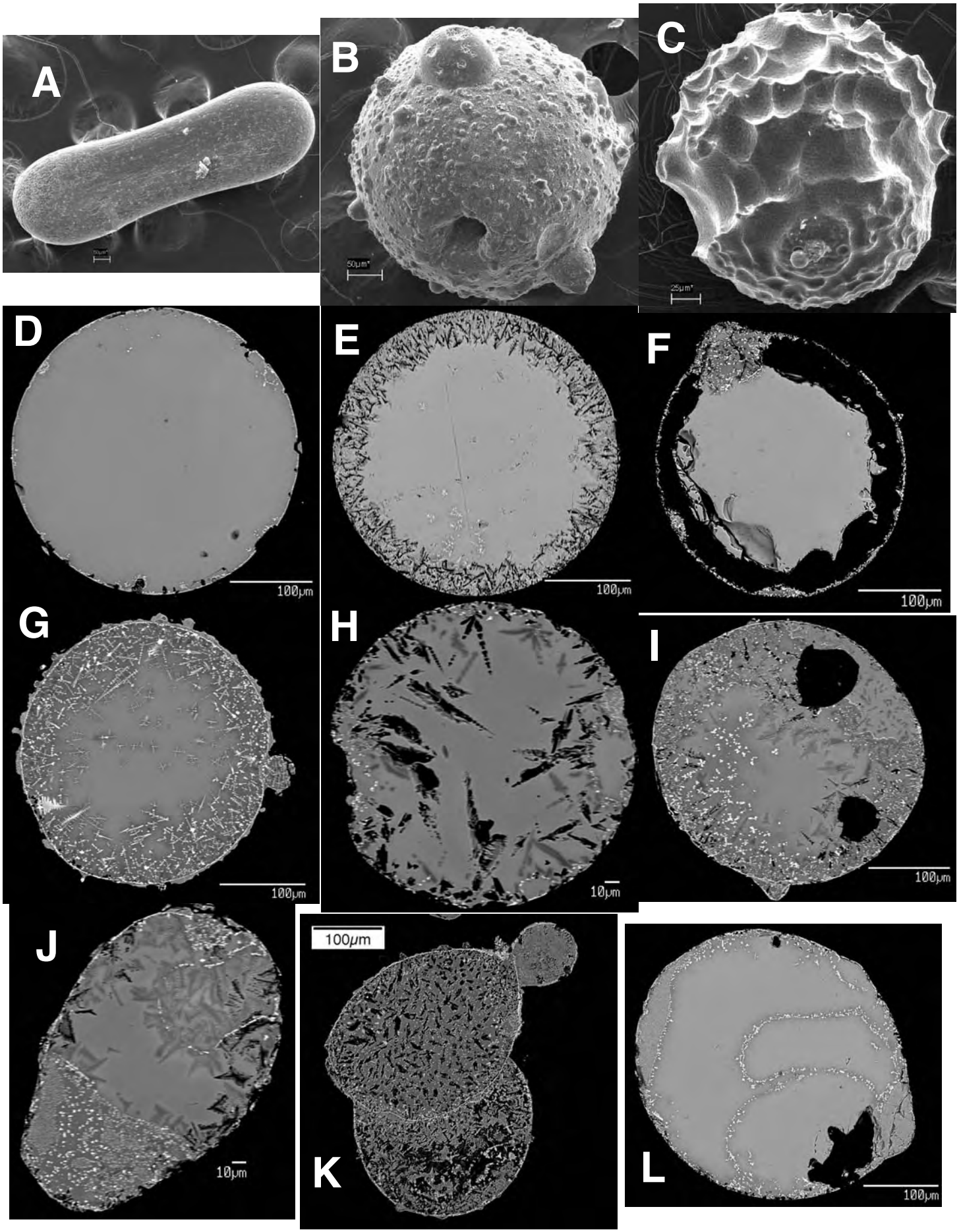
INITIAL RESULTS FROM A DETAILED ANALYSIS OF ELTANIN IMPACT SPHERULES. Frank T. Kyte[1], Chikako Omura[1], Rainer Gersonde[2], and Gerhard Kuhn[2], [1]Center for Astrobiology, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095-1567, USA (kyte@igpp.ucla.edu). [2]Alfred Wegener Institut fur Polar- und Meeresforschung, Postfach 120161, D-27515 Bremerhaven, Germany.

Introduction: Eltanin impact deposits record the only known km-sized asteroid impact into a deep-ocean (5 km) basin (at 2.5 Ma). First discovered as an Ir anomaly in sediment cores that were collected in 1965, the deposits contain mm- to cm-sized shock-melted asteroidal material (90%), unmelted meteorite fragments (10%; named the Eltanin meteorite), and trace impact spherules. Two oceanographic expeditions by the *FS Polarstern* in 1995 and 2001 explored 80,000 km^2 of the impact region, mapping the distribution of meteoritic ejecta, disturbance of seafloor sediments by the impact, and collected 20 new cores with impact deposits in the vicinity of the Freeden Seamounts (57.3S, 90.5W). Analyses of sediment cores show that the impact disrupted sediments on the ocean floor, redepositing them as a chaotic jumble of sediment fragments overlain by a sequence of laminated sands, silts and clays deposited from the water column. Overprinted on this is a pulse of meteoritic ejecta, likely transported ballistically, then settled through the water column. At some localities, meteoritic ejecta was as much as 5 to 50 kg/m^2. This is the most meteorite-rich locality known on Earth.

This Study: Here we report the initial results of a detailed study of the impact spherules, a phase that has only been described briefly by Margolis et al. (1991; Sci. **251**, 1597) who showed that they are composed mostly of a basaltic glass, likely derived from the Eltanin asteroid, with significant Na from the seawater target. Magnesioferrite spinels in these spherules are similar to those found in K/T boundary spherules. We are now studying the distribution of spherules in sediment cores to compare their distribution relative to the other, larger, impact particles and to the overall impact region. As part of the broad impact study, ~900 sediment samples from 17 cores were sieved into >2000μm, 1000, 500, 250, 125, 63, silt and clay fractions. The >500 μm fractions were all handpicked to separate the asteroidal metlrock and meteorite fractions. The spherules are in the <500 μm fractions and are therefore much more difficult to work with. We are handpicking spherules from the >250 and >125 μm splits from about 100 samples from 11 cores. To date, we have picked 370 from the >250 fraction and 1630 from the >125. The peak concentration of spherules is ~100/g of sediment in core PS58/281-1 in a layer with ~80% total meteoritic ejecta. Our initial work shows that spherules are most concentrated in cores near the Freeden Seamounts that also have high concentrations of coarse ejecta, with the highest abundance in core 281 at >300 spherules/cm^2. ~90% of the spherules are composed mainly of a single spherical droplet. Other forms include dumbbell, compound, teardrop and other complex shapes. ~200 spherules have now been mounted in polished section for more detailed analyses of their bulk chemical and mineral compositions.

Figs A-C are secondary electron images of spherules. Figs D-L are backscatter electron images, best viewed in PDF. Spherules stretched by rotation, such as teardrops and dumbbells (A) are rare (~4%). Most spherules formed in a droplet-rich environment and have at least a few small spherules attached to their surface (B is an extreme, but not uncommon example). A few percent are strongly etched by seawater, giving this sculpted surface (C). Note that in D-L all examples have a thin bright rim composed of magnesioferrite spinel; this is typical. Most spherules are composed almost entirely of glass (D,L). Internal crystallites are the exception rather than the rule, but a wide variety has been observed. Many have crystallization only near the rim, as in E, where pyroxene crystallites have been mostly dissolved - a few are preserved but too small to analyze. Perhaps crystallization along the rim leads to dissolution inside the spinel rim, as in F, which could produce the sculptured spherules (C). Spinel crystallites are common - in G, larger crystals are $(Mg_{0.72}Fe_{0.17}Ni_{0.08}Mn_{0.02})(Fe_{1.45}Al_{0.31}Cr_{0.23})O_4$.Olivine crytallites are occasionally preserved and analyzable – in H they are Fo_{93} with 2.5 wt% Al_2O_3.Spherule I is a complex spherule with pyroxene and spinel crystallites. Pyroxenes are lo-Ca and very difficult to analyze. One preliminary analysis <u>appears</u> to indicate a comp o-sition of $En_{54}Fs_{20}Wo_{16}Jd_{10}$ with 11.2% Al_2O_3. Note the bright area on the upper right side of I, which appears to be material accreted to the surface of this spherule. Although too small to analyze, the crystallites here appear to be olivine. Growth of spherules by combination/accretion is common. Spherule J is a combination of a pyroxene- and a spinel-bearing spherule. Note the line of spinels within the pyroxene portion: this may the rim be another accreted droplet. Some droplets combined while nearly solid (K). Others grow by accretion of liquid droplets as with L, which formed from at least six droplets.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