SEARCH FOR EXTRATERRESTRIAL PARTICLES IN SEDIMENT FROM THE SOUTH PACIFIC BARE ZONE. K. Schreiber[1,2], F. J. Stadermann[1], C. Floss[1], D. Rea[3], M. Lyle[4]. [1]Laboratory for Space Sciences and Physics Dept., Washington University, St. Louis, MO, USA; [2]University of Chicago, Chicago, IL, USA; [3]Dept. of Geological Sciences, University of Michigan, Ann Arbor, MI, USA; [4]Dept. of Oceanography, Texas A&M University, College Station, TX, USA. (Contact email: floss@wustl.edu)

Introduction: Micrometeorites and IDPs dominate the flux of extraterrestrial material to the earth [1] and have long been collected from the stratosphere, polar ice, and deep-sea sediments [e.g., 2]. Recent efforts have focused on locating new locations from which cosmic dust grains can be easily collected and identified. Certain regions in the Pacific Ocean with limited sources of terrestrial contamination have been of particular interest, as they potentially allow for more concentrated collection and identification of extraterrestrial dust [e.g., 3].

A recent survey of a number of sites in the southwest Pacific Basin, carried out in preparation for a full drilling proposal to study paleo-oceanography and –climatology resulted in the surprising discovery of a large region in the central South Pacific where the seafloor was largely sediment-free, termed the South Pacific bare zone [4]. Investigation of the area revealed that broad areas of the ocean floor had accumulated less than five meters of sediment over more than 80 million years [4]. This very low sedimentation rate suggests that the area may contain an enhanced concentration of extraterrestrial matter in the sediment that does accumulate. We therefore initiated a reconnaissance study of sediment cores obtained from this region in order to investigate this possibility. Here we report our initial results.

Samples and Experimental: Our samples were obtained from sediment taken from the top 1–2 cm of core MV0502-15TC (recovered, together with MV0502-15JC [5], at 31º 42.194'S, 143º 30.331'W; 5082 m water depth in the South Pacific bare zone). The top 2 m of the core are dominated by dark brown zeolitic clay, followed by a rust-red metalliferous clay in the lower portion [5]. We prepared two grain mounts by depositing sediment from a water-methanol suspension onto Nuclepore filters that were subsequently Pt-coated and mounted on C tape-covered SEM stubs for optical and SEM examination. Grains from mount 1 are from a sediment fraction that was sieved to select particles >50 µm in size. Mount 2 consists of sediment that was size-sorted by repeated settling in suspension and removal of the upper finer fractions.

Optical (Fig. 1) and secondary electron (SE) images (Figs. 2, 3) were taken of both mounts, and EDX spectra were obtained from over 400 particles to document the different grain types present and to search for extraterrestrial candidates. Potential extraterrestrial particles were identified on the basis of their chondritic compositions, following criteria outlined in [6]. We also selected several particles with porous textures (Fig. 2, left) for further characterization. Nine (five chondritic, four porous) grains with sizes from ~20–50 µm (all from mount 2) were picked with a micro-manipulator and pressed into high purity Au foil for more detailed investigation. Additional EDX spectra, as well as Auger spectra and element (C, O, Si, Mg, Fe, Al, Ca, S) distribution maps were acquired.

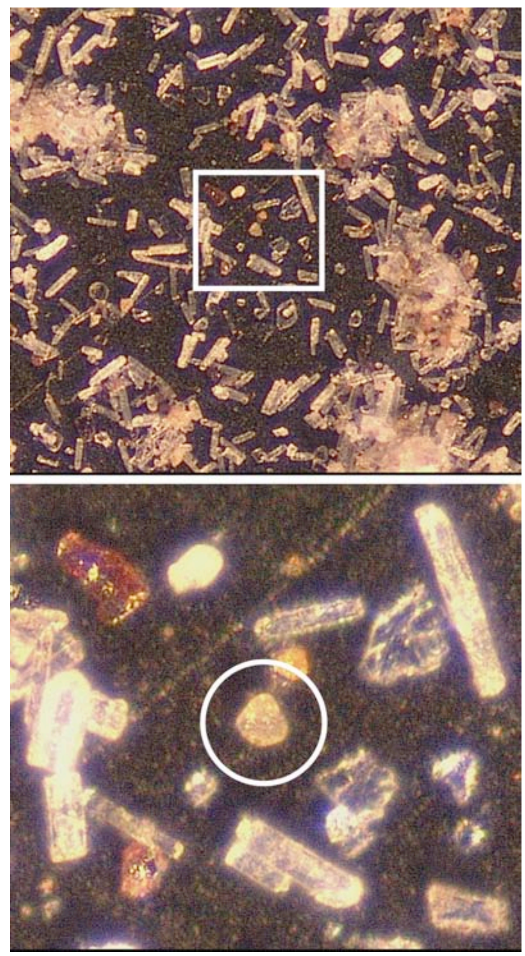

Figure 1. Reflected light images of grain mount 2 (top) and chondritic candidate 2-8-7.012 (bottom). The field of view is ~325 µm (top) and ~100 µm (bottom).

Results: The vast majority of the particles on the mounts are translucent, elongate rods, typically about

20-50 μm long (Fig. 1), whose EDX spectra are dominated by Si and Al, with minor Na, K, and Ca; these are most likely zeolites [e.g., 5].

Secondary electron images of the four porous particles show that all have fine-grained aggregate textures (Fig. 2, right). EDX spectra indicate that they are dominated by either Fe or Mn (≥45 wt.%), with lesser amounts of Si, Mg, Al, Ca, P, and/or K. These are most likely fragments of ferromanganese nodules. Such nodules are common in ocean sediments and are thought to be of hydrogenous and/or diagenetic origin [e.g., 7].

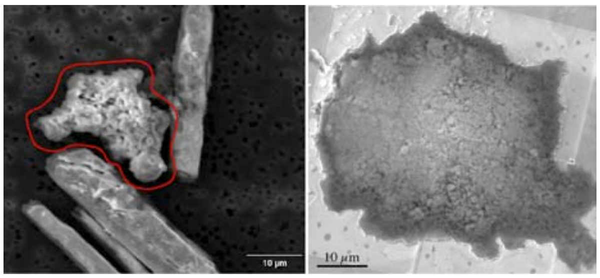

Figure 2. Secondary electron images of particle 2-7-9.009 on the Pt-coated Nuclepore filter (left) and pressed into Au foil (right).

The five chondritic particles represent about 2% of non-zeolitic grains identified by SEM-EDX. These grains have more compact platy or blocky textures (Fig. 3); crystal faces are apparent on some grains. All grains contain Si, Mg, Fe and/or Al, with one or more of the first three elements dominant over Al [e.g., 6]; three of the grains also contain Ca. None contain Mn or P. One grain (2-12-8.022) has a composition similar to that of a high-Ca pyroxene. The remaining particles show no obvious stoichiometry. Field emission secondary electron images taken after the particles were pressed into Au show that one grain (2-12-7.009; Fig. 3) has an aggregate structure, consisting of multiple grains up to ~5 μm in size.

Discussion: The candidate particles that we identified by SEM-EDX have chondritic compositions, but do not have the fluffy aggregate textures typical of chondritic porous interplanetary dust particles [8]. The textures of the particles also do not resemble typical cosmic spherules. In addition, element/Si ratios in most cases deviate significantly from CI values, although they are within the ranges observed for a large suite of stony cosmic spherules analyzed by [9]; an exception is 2-8-9.020, which has chondritic Mg/Si and Fe/Si ratios. Microprobe analyses, including minor elements, are planned and may provide additional constraints.

Detailed study of a suite of cores from the late Pliocene Eltanin impact site in the south Pacific indicates a known strewn field of ~660 x ~200 km [10]. The South Pacific bare zone is approximately 4000 km NW of this area. Impact debris is not expected here, but dust settling from the impact may be concentrated in this region. Although our initial results are ambiguous, continued study may offer the possibility of identifying dust from the impact, in addition to other extraterrestrial material. Identifying likely grains in this manner is time-consuming, given the dominance of zeolites in the sediments; future work starting with an initial magnetic separation [e.g., 9] will help concentrate likely candidates.

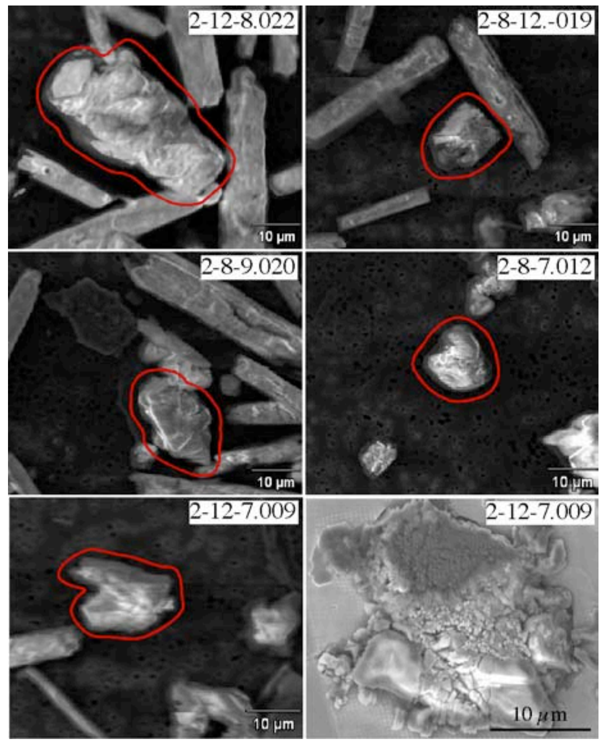

Figure 3. Secondary electron images of chondritic candidate particles. Images outlined in red are from the Pt-coated Nuclepore filter; bottom right image is of particle 2-12-7.009 after it was pressed into Au foil.

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