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LDEF POST-RETRIEVAL EVALUATION OF EXOBIOLOGY INTERESTS

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Cursory examination of LDEF (Long Duration Exposure Facility) shows the existence of thousands of impact craters of which less than 1/3 exceed 0.3 mm in diameter; the largest crater is 5.5 mm. Few craters show oblique impact morphology (low impact angle) and, surprisingly, only a low number of craters have recognizable impact debris (ejecta spray patterns, crater interior impactor residue). Study of this debris could be of interest to Exobiology in terms of C content and carbonaceous materials. All craters > 0.3 mm have been imaged and recorded into a data base by the preliminary examination team (the "A-Team"). Various portions of LDEF surfaces are contaminated by outgassed materials from experimenters trays, in addition to LDEF autocontamination and impact with orbital debris not of extraterrestrial origin.

Because IDPs (interplanetary dust particles, a.k.a. cosmic dust) nominally impacted LDEF at velocities > 3 km/s, the potential for intact survival of carbonaceous compounds is mostly unknown for hypervelocity impacts. Calculations show that for solid phthalic acid (a test impactor), molecular dissociation would not necessarily occur below 3 km/s, if all of the impact energy was directed at breaking molecular bonds, which is not the case (e.g., most energy is used for crater formation and impactor fragmentation). We performed hypervelocity impact experiments (LDEF analogs) by using the Ames Vertical Gun Facility. Grains of phthalic acid and the Murchison meteorite (grain dia.= 0.2 mm for both) were fired into Al plate at 2.1 and 4.1 km/s, respectively. Laser ionization mass spectrometry (LIMS) microanalyses of the impactor residues confirm that phthalic acid molecules remain intact on impact at 2.1 km/s and some of the carbonaceous compounds in Murchison retain their molecular integrity on impact at 4.1 km/s. We assume that some of the LDEF craters were formed at impact velocities < 5 km/s and conclude that meaningful biogenic elemental and compound information can be obtained from IDP impacts on LDEF.

An LDEF catalog of preliminary observational data and imagery will be made available within the 1991 fiscal year (Johnson Space Center, NASA). Sample analysis opportunities will also be announced in the near future through the LDEF Project Office (Langley Research Center, NASA).