mission would be challenging and difficult, therefore expensive: the estimated cost is roughly a billion dollars. An obvious way to make such a mission more affordable is by international cost-sharing. To this end, a joint NASA-ESA Science Definition Team (SDT) for a hypothetical Comet Nucleus Sample Return Mission was set up a year ago. Four meetings have been held, and the group's report is nearing completion. Some highlights of the report are discussed.

Target comet. This should be a short-period comet with a relatively high perihelion, and with evidence from its orbit and activity of a relatively short residence time in the inner solar system. No particular comet is singled out; an evolving "stable" of candidate comets should be maintained to draw from at whatever time the mission becomes possible.

Mission profile. A variety of mission profiles are being examined, some of which depend upon a new source of reaction thrust, solar-electric propulsion. The mission duration for most options is 6-8 years.

Sampling. In the absence of any real knowledge of the physical consistency of nuclear material (solid ice? fluffy snow?), this is hard to plan. The SDT has attempted to keep the sampling plan simple and realistic. Three samples should be taken: (1) 1-5 kg collected from the surface of the nucleus; it is anticipated that this will be ice-depleted mantle material, *i.e.*, aggregated cometary dust. (2) A $\sim$ 10 kg core sample of ice plus dust, one to two meters in length, with at least large-scale stratigraphy preserved. This should be stored in a vented container, to prevent rupture by pressure built up by outgassing of the most volatile ice components. (3) A 10-100 g ice and dust sample tightly sealed in a container large and strong enough to contain and preserve whatever vapors outgas from it. The samples should be maintained at $< \sim$ 160 K after collection. (Passive radiative cooling can do this fairly easily on the trip home, but active refrigeration will be necessary near the earth.) It should be noted that since a short-period comet is to be sampled, its interior will have been warmed by the sun to something like 160 K, and regrettably some volatiles that were present in the $\sim$ 20 K nucleus in the Oort cloud will have outgassed already.

Time frame. Here there is a major mismatch between NASA and ESA. ESA has formulated a "Horizon 2000" program, which defines four major "Cornerstone" missions to be flown by the end of the century. One of them is a Comet Nucleus Sample Return. ESA effectively has allocated approximately $400 million to this mission. NASA's plan is to fly CRAF before a sample-return mission; however, CRAF is not yet an approved mission. Because of this and the U.S. loss of launch capability, it could be well after 2000 before NASA is able to participate in a Comet Nucleus Sample Return mission.

A TEST OF SOLAR SYSTEM ABUNDANCE SMOOTHNESS

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Carbonaceous chondrite (C1) elemental abundances are thought to represent the average solar system ("cosmic") composition (see e.g. Anders and Ebihara, 1982) based on the agreement between C1 and photospheric abundances and on the smoothness of heavy element abundances of odd mass nuclei when plotted as a function of mass number (A). The latter argument presently determines the accuracy of the identification.

To test C1 elemental smoothness, we have analyzed clean, homogenized C1 meteorite samples, using conventional PIXE analysis (Si[Li] detector with filters), with millimeter-sized, $\sim$ 150 nA, 3.0 MeV proton beams. Good sensitivity (to ppm levels) is obtained in a single analysis for the range of elements: Ni to Mo. While C1 abundance tables are compiled from separate analyses, using different samples and a variety of techniques, we have the advantage that all corrections used to convert the Xray line intensity to an absolute concentration are either constants or smooth functions of atomic atomic number. To a good approximation, the smoothness of the abundance curve should only be affected by the Xray counting statistics.

Data for two C1 meteorites have been processed following Rogers *et al.* (1984). Elemental concentrations have been determined relative to Ni. The agreement between the two meteorites is excellent for all elements except Br and Y. The agreement of our results with Anders and Ebihara (1982) is also good in general, although comparison for As is clouded by Pb L line interferences, and we have only upper limits for Nb. However: (1) one sample shows a distinctly higher (by 50%) Br abundance, which may reflect sample heterogeneity or contamination, and (2) we are systematically lower for Sr, Y, Zr and Mo, normally by about 20-30%, but, in one case, by 75% for Y. It is possible that there are systematic errors in background subtraction in this region; Y would be most sensitive to such errors. Additional work is required to confidently assign appropriate errors for all elements, but an average of the present, tentative abundances in this region would yield an odd-A abundance curve dropping relatively smoothly above mass 85, contrary to the sharp positive Y spike noted in Anders and Ebihara (1982), although a spike could be interpreted in terms of s-process nucleosynthesis because of the anomalously low n-capture cross section for ^{89}Y.

It appears that elemental abundance smoothness is only approximate, with possible deviations of 30% to perhaps even 50%, e.g. in the Se-Br region. However, explanations for non-smooth behavior may be understandable with the aid of general ideas of n-capture nucleosynthesis. As C1 abundances are refined, it could be that the lack of elemental smoothness may provide the strongest argument for the identification of C1 with primordial solar system abundances.

Anders and Ebihara, 1982. *Geochim. Cosmochim. Acta* **46**, 2363.
Rogers *et al.*, 1984. *Nucl. Instrum. Meth.* **B3**, 671.

PRELIMINARY STUDIES OF THE YAMATO-791839 UREILITE WITH MELT-PORTION

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Of processed samples among about 3,700 of the Yamato-79 meteorite collection, there was found the second ureilite with unique portion of melted and crystallized.

Yamato-791839 specimen is classified as an ureilite for its mineral assemblages and texture, with some melts, melt-portion and fusion crust. The melt-portion has unique texture of many euhedral grains of olivine in brown glass and very simple mineral assemblages of olivine and opaques. Drop-formed intergrowths of metal and sulfide were recognized in the melt-portion.

This specimen is 5.8 grams in weight, small, irregular shaped stone. The melt-portion is about 5 to 8 mm thick and full of vesicles such as scoria or piece of coke, and appears ropy lava like shape of brownish yellow and dark grey-black in color. However, its core (unmelted portion) is coarse grained of yellowish brown to dark brown in color and differ from those textures of brecciated and recrystallized ureilite.

The thin section from the core-portion shows all characteristics of ureilite texture, and consists of coarse grained olivines and pyroxenes with little carbon matter and opaques. The compositions of olivines ranged Fa17.1 to Fa25.4 with average composition Fa24. The composition range in pyroxenes is En68.8-82.3Fs10.0-15.7Wo4.5-21.0.