Human Missions to the Fifth Planet Ceres

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A final mission destination scenario is developed and presented for my space colonization architecture, using ground truth from the high and mid level mapping of Ceres, and as a direct challenge to a recent Planetary Society essay by Louis Friedman where he claims colonization of deep space is impossible.

Ceres is a massive planetoid in the center of the asteroid belt between Mars and Jupiter, and possesses the fourth largest surface gravitational attraction moderately acceptable for human habitation, after the Earth, Mars and the Moon. With a solar irradiance of only 1/10th that of the Earth, it is most likely the final practicable location for permanent human space colonization within the entire inner solar system. Ceres is a water abundant ice world, due to the circumstances of gas giant planetary migration in the early evolution of the solar system, possessing a frozen deep ocean lying just below its dry, disordered surface crust and regolith. It appears that in many areas water vapor cryovolcanism and crustal eruption has occurred in the past, leaving bright deposits of salts and minerals observed widely across the body. The surface soils of Ceres appears to consist of widespread ammoniated and hydrated phyllosilicates, and other various clay like minerals, interspersed and contaminated with a variety of impact materials.

The orbit of Ceres is inclined 10 degrees. The lack of any atmosphere necessitates propulsive transfers. Since the majority of the observed crustal exudations are in the equatorial and mid latitudes, and not near the poles, an equatorial approach to surface operations is indicated. Equatorial geosynchronous orbital altitude is roughly a single diameter of the body of the planet, so orbital facilities in equatorial orbits provide fortuitous opportunities for the nearby remote controlling of surface mining operations. Those operations will require humans in orbit about Ceres due to deep space communications delays. With a surface gravity of merely 1/30th of a gee, Ceres still presents a massive gravity field compared to all other asteroids, and thus surface mining, drilling and excavation can occur immediately with little pollution consequences besides material that must be pulled from the interior and placed on the surface. With Ceres' low gravity relative to the Earth and Mars those operations will not be particularly difficult.

Without intimate knowledge of the composition of the surface materials, the simplest way to proceed would be to drill down through the surface crust into the frozen salty ocean, and then melt the water with a radioactive heat source and pump it to the surface for collection and storage. It may even be more expedient to just vaporize the water and recondense it as distilled water while excavating it out. Presumably distilled water shipped up from the surface would provide the initial shielding mass for the initial equatorial geostationary teleoperating habitats, absolutely required to conduct mining operations. Therefore the surface of Ceres and its deep tunnel mining would be the ideal arena in which to test and apply nuclear power to deep space mining operations, although the solar powered orbital teleoperating facilities could easily proceed in the reduced solar irradiance, by applying massive space solar power. Electrical mining operations would proceed by massive solar in orbit and on the surface, and thermal nuclear energy would be applied to the deep mining, the excavation of oceanic resources and habitat heating, as well as backup electrical. Ceres represents an ideal testing ground for any cold deep space asteroid and comet mining capabilities, as well as for deep underground artificial gravity living spaces. An escape velocity of 510 meters per second makes classical mass drivers and space elevators possible.