MANNED NEO MISSION EVA CHALLENGES.

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Introduction: The President has proposed to land astronauts on an asteroid by 2025. However, Manned NEO (Near Earth Objects) Missions will present a host of new and exciting problems that will need to be better defined and solved before such a mission is launched. Here I will focus on the challenges for conducting asteroidal EVAs. Specfically, crew locomotion, sampling, drilling, documentation, and instrument deployment issues arising from the micro gravity environments associated with NEOs. Therefore, novel methods and techniques will need to be developed and tested in order to achieve specific mission science objectives. Walking or driving on the surface will not be a realistic option due to the small sizes (10's to 100's of meters in diameter) and hence extremely low gravity of the present day known candidate NEOs. EVAs will have to be carried out with crew members either using a self propelled device (akin to the MMU and SAFER units used on Shuttle/ISS) and or tethers. When using tethers a grid system could be deployed which is anchored to the asteroid. These anchor points could be inserted by firing penetrators into the surface from the spacecraft while it is still at a safe standoff distance. These penetrators would pull double duty by being laden with scientific instrumentation to probe the subsurface. Dust and debris generated by sample collection and locomotion in a microgravity environment could also pose some problems that will require forethought.

The six Apollo lunar landing expeditions provide us with the only ground truth and experience for manned planetary exploration to date. Therefore, it seems reasonable to assume that some of the guiding principles and lessons learned from Apollo regarding crew geology training will be useful to the planning for any new manned exploration missions (Moon/Mars/Asteroids). The Apollo astronauts received extensive geologic field training to insure maximum scientific gain and but also to reduce risk to the EVA team. These field exercises proved to be invaluable and contributed greatly to the achievement of all lunar surface science objectives (including intelligent sample acquisition and documentation). Post mission debriefs indicate that the Apollo astronauts felt that they had been too rigidly scheduled during their surface EVA's and recommended that this should change. They also stated that the crew should be "essentially autonomous" and have a more dynamic role in mission planning.

Apollo 17 geologist astronaut, H.H. Schmitt, estimated that during Apollo, the scientists had acquired 75% of the operations skills of the pilots in the program, while the latter had attained 25% of the field geology skills typical of active field geologists. So when should the astronaut field geology training program begin? We feel that it is not too early to begin preparing for these exploration missions now because: (1) The art and skill of Field Geology can only be learned by being in the field. (2) Additionally, Field Geology is a cumulative science, meaning the more experience you get the better you get. (3) The links should be forged between the science, operations, and astronaut communities now because it will take time to achieve the collective experience level necessary for the proper interaction of these communities. The establishment of an ongoing program of scientific field exercises geared toward planetary surface exploration will allow astronauts to gain valuable experience in managing a field research program, practice on site decision making, cope with changing research strategies, and to develop the cross training necessary for a successful expedition. Training the current cadre of astronauts is also important because some will have senior management positions by the time we are ready for this new phase of exploration.