# VALIDATION OF DECOMPRESSION SICKNESS RISK MITIGATION PROTOCOLS FOR PLANETARY SPACEFLIGHT MISSIONS

Andrew F. J. Abercromby[1], Alejandro Garbino, E. Lichar Dillon, Patrick Estep, Monica Hew, Grant Harman, Karina Marshall-Goebel, Jason Norcross, Kadambari Suri

[1]NASA Johnson Space Center, Houston, Texas 77058

BACKGROUND: Apollo missions used a 100% $O_2$ cabin atmosphere which effectively eliminated the risk of decompression sickness (DCS) during extravehicular activity (EVA) on the moon. NASA's future missions to the moon and Mars are expected to use nitrox gas mixtures of up to 34% $O_2$, 66% $N_2$, which will reduce flammability risk compared with Apollo, but will necessitate Oxygen prebreathe prior to EVA to reduce DCS risk to acceptable levels. Prebreathe protocols used on the space shuttle and International Space Station are validated for microgravity EVAs, but the significantly increased risk of DCS during equivalent ambulatory EVAs make these protocols inapplicable to planetary EVA. An "exploration atmosphere" of 56.5 kPa (8.2 psia), 34% $O_2$, 66% $N_2$ has been recommended by NASA as a compromise that balances prebreathe duration, hypoxia, and flammability risk, assuming a 29.6 kPa (4.3 psi) spacesuit. However, this atmosphere may not be used for vehicles that do not support frequent EVA, and with commercial providers and international providers expected to provide landers, pressurized rovers, habitats, and spacesuits, different combinations of vehicle and spacesuit atmospheres are possible and will each require validated prebreathe protocols.

OVERVIEW: Key components of a multi-year strategic roadmap include: 1) Establish hypobaric chamber facility capable of supporting 8-person EVA prebreathe validation tests at saturation atmospheres up to 36% $O_2$; 2) validate an EVA physical workload simulation for use during prebreathe validation testing; 3) validate the recommended "exploration atmosphere" prebreathe protocol; 4) validate prebreathe protocols for additional atmospheric combinations that bound the most likely potential operating ranges of future vehicles and spacesuits; and 5) update DCS risk estimation models based on results of prebreathe validation studies.

DISCUSSION: Details and data from completion of the first two steps of the strategic roadmap will be presented; the third step is currently underway, with pilot results provided in a companion presentation. Steps four and five will require a multi-year series of chamber tests; collaborations are being pursued.