Fiscal Year:	FY 2013	**Task Last Updated:**	FY 02/26/2013
PI Name:	Gernhardt, Michael Ph.D.		
Project Title:	Mechanisms of Musculoskeletal-Induced Nucleation in Altitude Decompression Stress II		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **DCS**:Risk of Mission Impacts and Long-Term Health Issues due to Decompression Sickness		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	Directed Research
Start Date:	02/07/2013	**End Date:**	02/28/2016
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: End date changed back to 2/28/2016 as work ended at that time, per PI and K. George/JSC (Ed., 3/14/17) NOTE: Extended to 2/28/2017 (original end date was 2/28/2016) per K. George/JSC (Ed., 2/9/16)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Pollock, Neal (Duke University Medical Center) Vann, Richard (Duke University Medical Center) Conkin, Johnny (Universities Space Research Association)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Musculoskeletal activity has the potential to both improve and compromise decompression safety, depending on the intensity, sequence, and level of tissue supersaturation. Exercise enhances inert gas elimination during oxygen breathing prior to decompression, but it may also promote bubble nuclei formation, which can lead to gas phase separation and growth resulting in increased decompression sickness (DCS) risk. The timing, sequence, and intensity of musculoskeletal activity may be critical to the net effect, but there are limited data available. This study will help determine the cost/benefit relationship of exercise, describe underlying mechanisms of nucleation in exercise prebreathe protocols, and quantify variable risk in gravity and microgravity environments when musculoskeletal effort can differ substantially. Data gathered during prebreathe reduction program (PRP) studies combined multiple variables (prebreathe exercise and microgravity simulation) to produce a procedure now used by astronauts preparing for extravehicular activity (the PRP Phase II protocol). The PRP results will serve as control data for this NASA/Duke multi-center study to investigate the influence of individual variables (exercise and ambulation) on bubble formation and the subsequent risk of decompression sickness. METHODS: Four separate experiments would replicate the PRP Phase II protocol, each with a different exception. A minimum of 25 and a maximum of 50 subjects would be tested. A Fisher's exact test would be used to compare the results of the test and control groups. Each experiment will be stopped when pre-defined accept/reject criteria are met. Experiment I – Subjects would be ambulatory during both preflight and at altitude instead of non-ambulatory throughout. Experiment 2 - Subjects would remain non-ambulatory during the preflight period and ambulatory at altitude. Experiment 2 would use the same statistical design, as experiment I. Experiment 3 – Subjects would be ambulatory during the preflight period and non-ambulatory at altitude. Experiment 4 - The order of heavy and light exercise would be reversed, with the light exercise occurring first. For experiment 4, all subjects will be nonambulatory during the pre extravehicular activity (EVA) and simulated EVA phases to match the phase II control group. Blood collection - Venous blood will be collected via needlestick at three points to investigate whether the concentration of microparticles is associated with the presence of venous gas emboli (VGE) or DCS. EXPECTED RESULTS. It is anticipated these experiments will show that for exercise prebreathe protocols, decompression stress is related to musculoskeletal nucleation, and that nucleation can be controlled to reduce decompression stress. Specifically, ambulation during the altitude exposure results in increased decompression stress, but that ambulation prior to altitude exposure does not. Additionally, the results will show that reversing the order of light and heavy exercise will result in higher decompression stress, suggesting that light exercise facilitates the removal of heavy exercise induced nucleation. These results will demonstrate that the degree, sequence, and level of supersaturation under which musculoskeletal activity is performed are important in controlling nuclei generation and subsequent decompression stress. Finally, there will be a correlation in the microparticle concentration observed prior to the decompression and the occurrence of decompression stress during the simulated EVA.
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research, which requires focused and constrained data gathering and analysis that is more appropriately obtained through a non-competitive proposal.
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2013.
Bibliography Type:	Description: (Last Updated: 10/31/2019)