

OVERVIEW OF NASA FINESSE (FIELD INVESTIGATIONS TO ENABLE SOLAR SYSTEM SCIENCE AND EXPLORATION) SCIENCE AND EXPLORATION PROJECT. J. L. Heldmann¹, D.S.S. Lim¹, S. Hughes², S. Kobs Nawotniak², B. Garry³, D. Sears¹, C. Neish⁴, G.R. Osinski⁴, K. Hodges⁵, M. Downs⁶, J. Busto⁶, B. Cohen⁷, B. Caldwell⁸, A.J.P. Jones^{3,9}, S. Johnson¹⁰, L. Kobayashi¹, A. Colaprete¹, and the FINESSE Team. ¹ NASA Ames Research Center, Moffett Field, CA, ² Idaho State University, ³ NASA Goddard Space Flight Center, ⁴ University of Western Ontario, ⁵ Arizona State University, ⁶ NASA Kennedy Space Center, ⁷ NASA Marshall Space Flight Center, ⁸ Purdue University and NASA Indiana Space Grant, ⁹ Planetary Science Institute ¹⁰ NASA Idaho Space Grant Consortium.

Introduction: NASA's FINESSE (Field Investigations to Enable Solar System Science and Exploration) project was selected as a research team by NASA's Solar System Exploration Research Virtual Institute (SSERVI). SSERVI is a joint Institute supported by NASA's Science Mission Directorate (SMD) and Human Exploration and Operations Mission Directorate (HEOMD). As such, FINESSE is focused on a science and exploration field-based research program to generate strategic knowledge in preparation for human and robotic exploration of other planetary bodies including our Moon, Mars' moons Phobos and Deimos, and near-Earth asteroids. FINESSE embodies the philosophy that "science enables exploration and exploration enables science".

FINESSE Science: The FINESSE science program aims to further understand the effects of volcanism and impacts as dominant planetary processes on the Moon, near-Earth asteroids (NEAs), and Phobos & Deimos. Planetary volcanism research focuses on the formation of volcanoes, evolution of magma chambers and the formation of multiple lava flow types, as well as the evolution and entrapment of volatile chemicals. Impact cratering research focuses on impact rock modification, cratering mechanics, and understanding the chronologic record of other planetary bodies.

FINESSE Exploration: The FINESSE exploration program assesses which exploration concepts of operations (ConOps) and capabilities enhance and enable scientific return. Exploration research is focused on robotic ConOps, science ConOps and mission capabilities, communications, and hardware capabilities.

Fieldwork: To achieve the science and exploration research goals, FINESSE conducts multiple terrestrial field campaigns to study features as analogs relevant to our Moon, Phobos, Deimos, and asteroids. These campaigns have thus far centered on Craters of the Moon National Monument and Preserve in Idaho for volcanics, and West Clearwater Impact Structure in Canada for impact studies.

Craters of the Moon National Monument and Preserve (COTM). COTM, in the surrounding east Snake River Plane (ESRP), is a relatively young (~2-15 ka) dominantly basaltic volcanic system that hosts a variety

of well-exposed undisturbed analogs to volcanic formations on the Moon and other planetary bodies. Nearly every type of lunar volcanic feature is represented at COTM and immediate surroundings, and thus COTM is an ideal analog for conducting FINESSE field science for comparative planetology studies. FINESSE research at COTM is focused on understanding the geologic history and setting of multiple volcanic features, using multispectral data to constrain the mineralogy of various lava flows, measuring surface roughness with implications for lava formation and evolution, and understanding the formation of phreatic craters and ballistic ejecta fields.

West Clearwater Impact Structure (WCIS). Located in northern Quebec, Canada, WCIS is composed of a large ~25 km diameter lake with a discontinuous ring of islands towards its interior. WCIS appears to possess one of the best records of impact melt rocks and breccias among terrestrial impact structures on Earth. FINESSE research at WCIS is focused on constraining the impact age through geochronology, assessing shock metamorphism and complex crater collapse, studying impact-induced geothermal activity, and characterizing unique impact features such as lineaments and melt veins.

Education and Communication (E&C): FINESSE conducts a robust E&C program. The flagship activity is Spaceward Bound, conducted with the NASA Idaho Space Grant Consortium, where we bring teachers to conduct fieldwork with the FINESSE team. Teachers take their field experience back to their classrooms to share the knowledge and excitement of planetary research with their students. FINESSE also supports additional E&C activities, including (but not limited to) other NASA Space Grant activity, International Observe the Moon Night, a NASA Museum Alliance seminar series, MIT K+12 video documentary series, NASA Open Houses, and KIGAM (Korea Institute for Geoscience and Mineral Resources) Creative Geo EduCamp for Students and Teachers.

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