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The Future of Global Mapping for Energy and Mineral Resources

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Geologic exploration has used multi-spectral satellite sensors such as Landsat and the Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER) to map lithology, soil and surface alteration of rocks for many decades. To date, detailed mineral mapping has only occurred from airborne imaging spectrometer systems such as the Advanced Visible/Infrared Imaging Specrometer (AVIRIS) and HyMap. Several efforts are currently underway to develop and launch the next generation of imaging spectrometer systems on satellite platforms for a wide range of Earth Observation goals. Many of these systems will include the full reflected solar wavelength range up to 2.5 μm and will be useful for geologic exploration. Sensors under development include EnMAP (Germany), HISUI (Japan), PRISMA (Italy), HERO (Canada), and HyspIRI (USA) [1-5].

Scientists, policy makers, and other stakeholders rely on accurate assessments of resource availability, location and quantity in order to make predictions of economic growth, energy supplies, and sustainable societies. Natural resources, including minerals for the built environment, fossil and renewable energy, are critical to the world economy. Exploration for and development of strategic mineral resources requires detailed mapping of surface cover over large areas in order to target high priority prospects or areas of interest. As compared to modern imaging spectrometer sensors, multi-channel satellite sensors such as Landsat and ASTER lack the ability to discriminate mineral types, mineral chemical compositions, and vegetation species type. Additionally, development of natural mineral and energy resources may have unintended consequences with impacts on soil and water quality. Historical mining has left many watersheds vulnerable to mobilization of mine waste through annual snowmelt, cataclysmic events such as fire, storms, or retaining pond breaches. Airborne remote sensing applications have been used to identify mineralogy and soil chemistry that are associated with contaminated soils and changes in pH, and can help identify watershed regions that should be prioritized for remediation. The launch of future imaging spectrometer sensors will allow for these types of assessments worldwide.

The Hyperspectral Infrared Imager (HyspIRI) is a proposed NASA satellite mission that would acquire visible to short wave infrared (VSWIR) imaging data in 10 nm contiguous spectral bands from 380 to 2500 nm with 30m ground sampling and seven moderately broad band multispectral thermal infrared (TIR) images between 8 and 12 μm with 60m ground sampling [5]. As part of a series of preparatory data collects, large regions of California, USA were observed using the AVIRIS and MODIS/ASTER (MASTER) airborne simulator instruments. Using these data, we have established the utility of HyspIRI in exploration for renewable energy and critical mineral resources, determining the landscape impacts of the development of large scale renewable and traditional fossil energy systems, and assessment of natural hazards associated with geologically recent volcanic activity. The presentation will summarize the use of HyspIRI prototype data to address surface compositions relevant to modern energy and mineral resource development and their impacts.

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