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Future Hyperspectral VSWIR and Multispectral TIR Spaceborne Instruments

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Laboratory instruments, field instruments, and airborne scanners have convincingly demonstrated the utility of hyperspectral visible-near infrared-shortwave infrared (VSWIR) (0.4-2.5 um) data for geologic applications. Mineral exploration has particularly benefited from this technology, with many economic ore deposits having been discovered from analysis of hyperspectral data. It is natural to dream of putting a hyperspectral scanner into space to provide global coverage. Up to now, the only hyperspectral instrument in orbit is NASA's Earth Observing 1 (EO-1) Hyperion instrument. Launched in 2001 as a technology demonstration, Hyperion continues to acquire very limited lines of data: 220 bands, 30 m spatial resolution, 7.5 km swath, and 100 km data strip. The limited coverage, however, has been applied to geologic mapping with great success [1,2]. Several space agencies are far along in their plans to put a VSWIR hyperspectral scanner into orbit. Germany's DLR has the Environmental Mapper (ENMAP) ready for a 2018 launch. Japan is planning on installing the Hyperspectral Imager Suite (HISUI) instrument on the Space Station in 2019. The Italian Space Agency is working on the Hyperspectral Precursor and Application Mission (PRISMA) scanner, with an unannounced launch data. These instruments share similar capabilities: 200-220 spectral bands, 30 m spatial resolution, 30 km swath width, and, most discouraging, limited coverage of the land surface as a sampling-only mission. Israel's joint effort with Italy, the Spaceborne Hyperspectral Applicative Land and Ocean Mission (SHALOM), has a 2020+ launch date, but has 10 m spatial resolution with a 10 km swath width; again only limited sampling. NASA's HyspIRI mission is in pre-Phase A study status. It is the only global, multi-year mapping mission; it combines a VSWIR hyperspectral scanner, and multispectral TIR scanner. The VSWIR instrument has 30 m spatial resolution, and 185 km swath width (like Landsat), with 16-day repeat.

Spaceborne instruments operating in the thermal infrared (TIR) designed for geologic applications have been few. Since 1982, single-channel TIR scanners, like the many scanners in the Landsat series, have provided temperature information, but no compositional information. This is equivalent to a panchromatic band in the visible, that only is sensitive to albedo differences. The primary geological application is volcano monitoring, looking for thermal anomalies. The only exception to this lack of operational multispectral scanners is the ASTER (Advanced Spaceborne Thermal Emission and Reflection Radioimeter) instrument, onboard NASA's Terra spacecraft, acquiring 5-band multispectral TIR images since 2000. Geologic applications using ASTER data have been described by many authors, for example [3,4], who were able to extract mineralogical information unavailable in the VNIR or SWIR wavelength regions. There is only one future multispectral TIR instrument planned by any space agency: NASA's HyspIRI scanner, in pre-phase A development [5]. It is planned to have 8 bands in the 4-13 um range, 60 m spatial resolution, 625 km swath width, and <5-day revisit.

[1] Kruse F 2012 Geomorphology 137:41-56
[2] KruseF et al. (2003) IEEE Trans. Geosci. Rem. Sens. 41:1388-1400
[3] Hulley G et al. (2015) GRL 42:7966-7976
[4] Hassan S et al. (2015) Arabian J. Geosci. 8:6853-6865
[5] Lee C et al. (2015) Rem. Sens. Env. 167: 6-19