MULTI-SCALE SPECTRAL SENSING APPLIED TO MINERAL AND HYDROCARBON EXPLORATION AND PRODUCTION

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Abstract: During the last decade, remote sensing applied to the exploration of mineral resources underwent a fundamental transformation from image processing to the extraction of spectral-mineralogical information, resulting in a much broader field of spectral geology, which encompasses technologies that contribute to the definition, confirmation and characterization of metallic, nonmetallic and hydrocarbon mineral deposits. These technologies increase human vision by allowing measurements far beyond the sensitivity of our eyes, which are non-destructive and are made without contact with targets, with high sampling density - something no other technology can provide. An escalating range of proximal and distal sensor technologies, producing multispectral, superspectral, hyperspectral and ultraspectral data in multipole scales, are progressively fostering the discovery, sustainable recovery and monitoring of mineral resources. These include field instruments, drill core profiling/imaging systems, airborne and satellite sensors. A goal of this paper is to demonstrate that these instruments, data and derived mineral and hydrocarbon information can provide new and key knowledge about the 2D, 3D and 4D geologic architecture and processes and further influence the choice of scientists and exploration managers. This demands innovative principles to design and create products so that uniform information is accurate and accessible in all scales, from hand samples and drill core, up to deposit/reservoir and large continental and oceanic settings. Here we addresses challenges encountered at each scale of measurement and across scales, for example, methods of georegistering field-based scans of outcrop and mine faces and comparisons of mineral information derived from core, outcrop, and regional imaging spectroscopy data. We also show emerging software and developing sensor technology to accomplish these objectives. Issues surrounding the advancement of remote sensing to achieve detailed, global surface mineral characterization are also covered. In the last several decades, airborne imaging spectrometers have been utilized to identify and map specific minerals and detailed variations in mineral chemistry at a local scale. However, since their origin more than 40 years ago, satellite optical sensors capable of world-wide coverage have made only modest advances in supplying Earth resource data for geologic studies and for mineral and energy exploration. This paper addresses issues surrounding the advancement of remote sensing to achieve detailed, global surface mineral characterization, including: large-area geologic mapping efforts, imaging spectroscopy in frontier areas, improvements in sensor technology, trajectories in national space programs, and other challenges to global mineral and hydrocarbon mapping.

PALAVRAS-CHAVE: SPECTRAL, REMOTE SENSING, MINING, ORE, IRON, REE, HYDROCARBON