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Satellite-Based Mapping for Lithium Pegmatite Mineral Exploration in Namibia: A Criteria-Based Approach

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The growing global demand for lithium (Li) requires innovative mineral exploration methods. Lithium pegmatites, a significant source due to their grade and conventional mining methods, represent a key target. In many cases, Li exploration methods involve observation of surface exposure or investigation through geophysical surveys. In this study we introduce targeting of Li pegmatites in Namibia using satellite-based mapping within a mineral system criteria framework. It integrates expert knowledge with remote sensing techniques to identify and prioritise exploration targets based on geological characteristics, such as source magma types, structural settings and host-rock metamorphic grade.

The study utilises a Bare Earth+ mosaic derived from the entire archive of ASTER satellite imagery. Every image is co-registered at the pixel level with atmospheric and vegetation suppression applied and the “barest” pixel chosen. The result is an enhanced representation of Earth's surface with optimal signal to noise ratio and minimum cover, allowing the most representative spectral signatures to be derived and targeted. The Bare Earth+ mosaic is the foundation for the regional multispectral lithological and alteration mapping, with processing tailored to the Li-bearing granitic pegmatite system and resulting mineral maps supporting target generation, spectral lithological mapping and prospectivity analysis.

Hyperspectral EMIT data are also integrated in the study, enabling enhanced mineral mapping and lithological discrimination. The additional spectral bands are used to further identify and map possible Li-rich pegmatites. Several key proxy clay minerals are used as vectors to highlight candidate pegmatite target areas. Variability in host-rock composition can be spectrally discriminated using both multi- and hyper-spectral data through careful use of Principal Component Analysis, and from the rocks and alteration styles that they highlight. This workflow facilitates rapid regional assessments of Li-pegmatite potential, enhancing target identification accuracy and reducing exploration risk.