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Identification of concealed geological structures in a Grassland Area in Inner Mongolia, China: A Perspective from Temperature Vegetation Dryness Index

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The Quaternary grassland cover of geological (mineral) bodies and structures is a major challenge in mineral exploration because the identification of grassland-concealed geological structures by geological field surveying becomes almost impossible. Geophysical exploration technique (e.g. magnetic surveying, gravity surveying, induced polarization method, etc.) could recognize the concealed geological structure by penetrating the covered overburden and detecting the signal from geological bodies under cover on the basis of physical differences between fracture zone and wall rock at a high cost. Comparatively, remote sensing provides a cost- effective and powerful tool to identify geological structures by image texture and thermal image information.

In this study, we used the TVDI and the singularity index technique to extract and strengthen anomalies potentially generated by concealed structures in a semiarid grassland area. Firstly, we extracted the TVDI from Landsat Enhanced Thematic Mapper Plus (ETM+) imaging and enhanced it by the singularity index technique. Then, we distinguished between the anomalies caused by concealed structures from the ones caused by valleys and applied apparent resistivity mapping of IP to evaluate the results.

The land surface temperature (LST)/normalized difference vegetation index (NDVI) of the study area showed no bare soil (i.e., low NDVI and high LST), within a landscape totally or partially covered by grass. The TVDI imaging showed an anisotropic pattern, with the low anomalies being NNE and NE oriented and a few produced by topography extending NW. The spatial framework of the anomalies was similar to the regional tectonic framework. Singularity mapping was a powerful method to enhance and delineate the weak anomalies by reducing the background influence. Geological mapping footprints and the interpretation of apparent resistivity mapping supported the adequacy and reliability of the TVDI method to identify concealed faults. By representing soil moisture, the TVDI could highlight anomalies associated with concealed faults and enhance false anomalies indicating gully in the negative topography locally. The TVDI was statistically independent of the slope and elevation but some anomalies overlapped drainage. The improvement of the TVDI method to reduce the drainage influence is an important challenge for future wide geological application.

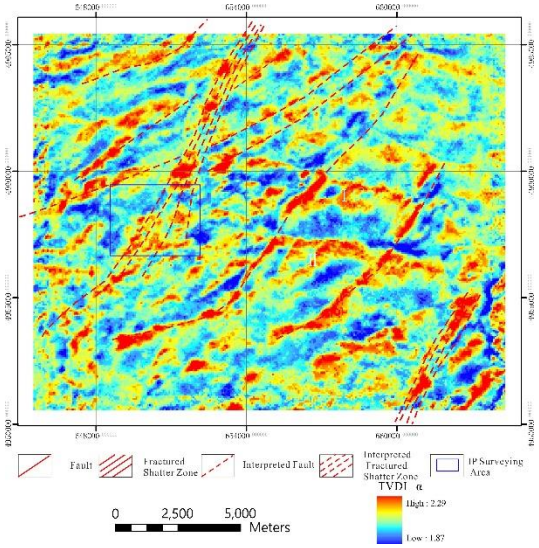

Fig.1 Singularity mapping of the temperature vegetation dryness index (TVDI) and geological interpretation results