REMOTE SENSING AND GIS TECHNIQUES APPLIED TO EPITHERMAL MINERALIZATION IN THE SIERRA MADRE OCCIDENTAL, CHIHUAHUA, MEXICO

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Introduction

The Sierra Madre region is rich in mineralized deposits, but it is hard to access because of the rugged area. Remote Sensing and GIS applications can help in mineral exploration projects and to describe part of the regional structural analysis. The purpose of this project is to carry out the study of linear, curvilinear, arcuate, and circular features. Independent data exists locating mines and mineral occurrences and there are 10 gold and silver operator mines in this region. It is of great interest to know the relationship between lineament intersections, caldera features, and the location of potential mineral occurrences.

Background

Sierra Madre Occidental (SMO) was formed because of different magmatic and tectonic episodes during the Cretaceous - Cenozoic times that are associated with the subduction of the Farallon plate beneath the western North American plate, evolving to the opening of the Gulf of California, by the Baja rift. Most of the surfaces of the SMO constitute two rock units which are the Lower Volcanic Series (LVS) and the Upper Volcanic Series (UVS). LVS is an andesitic rock family formed above a subduction zone during compressive, tectonic events known as the Laramide, The UVS is rhyolitic ash-flow tuffs issued from large calderas. They are emplaced during two pulses in Oligocene and Early Miocene .

Materials and methods

- Visual extraction of lineaments. Lineaments are observed and digitized manually from Landsat 8, (Band 8) (15 m resolution) imagery by the user after using directional filters to enhance the edge of the image.
- RockWorks16 Software is used to show the azimuthal (directional) data for both the visually
- Digital Elevation Model (DEM) is used to make elevation profiles.

Results

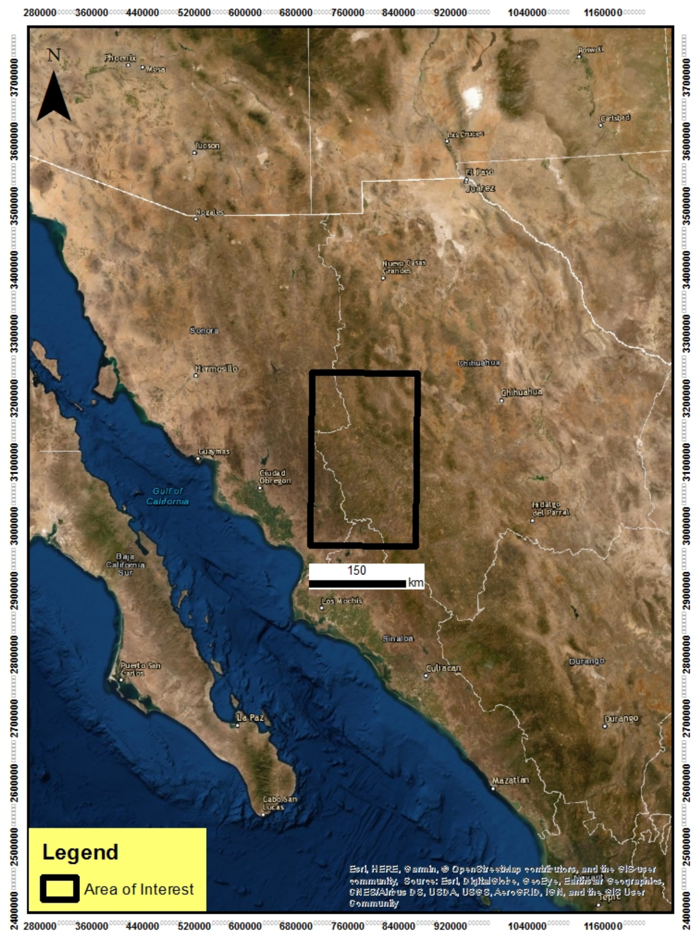

Figure 1: Map shows the area of interest (270×164 km).

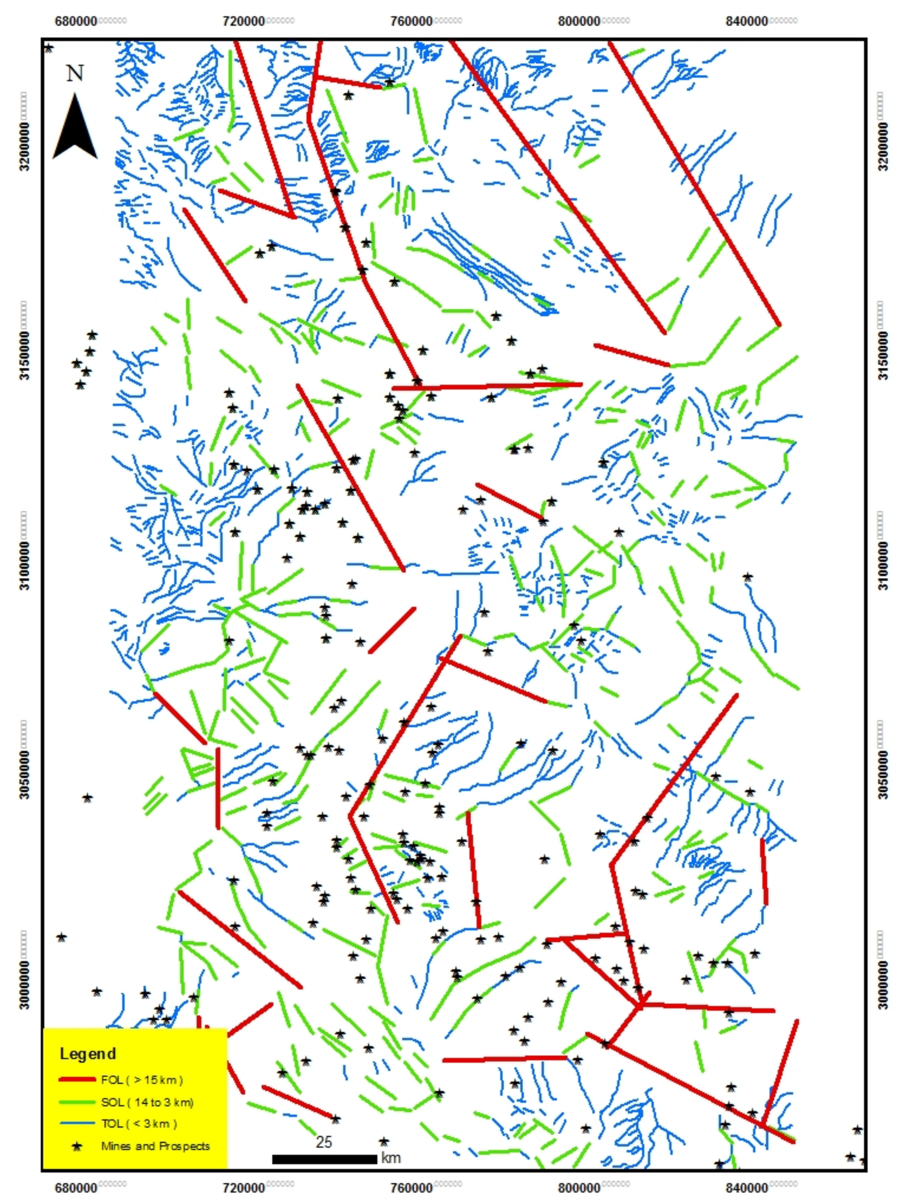

Figure 2: the map shows the Frist Order Lineament (FOL) (greater than 15 km), , Second Order Lineament (SOL) (14 to 3 km, ,Third Order Lineament (TOL) (less than 3 km) , and mines or prospects in the area of interest

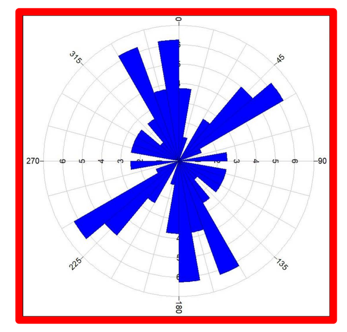

Figure 3: This figure shows the Rose diagram for

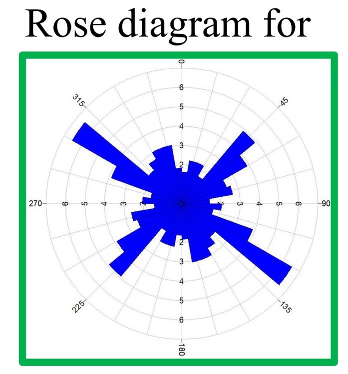

Figure 4: This figure shows the Rose diagram for (SOL).

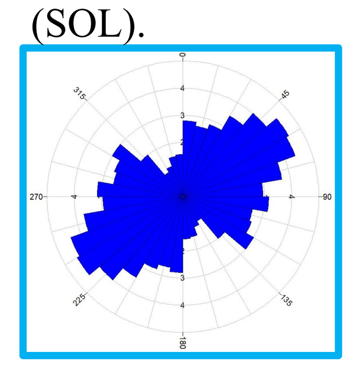

Figure 5: This figure shows the Rose diagram (TOL).

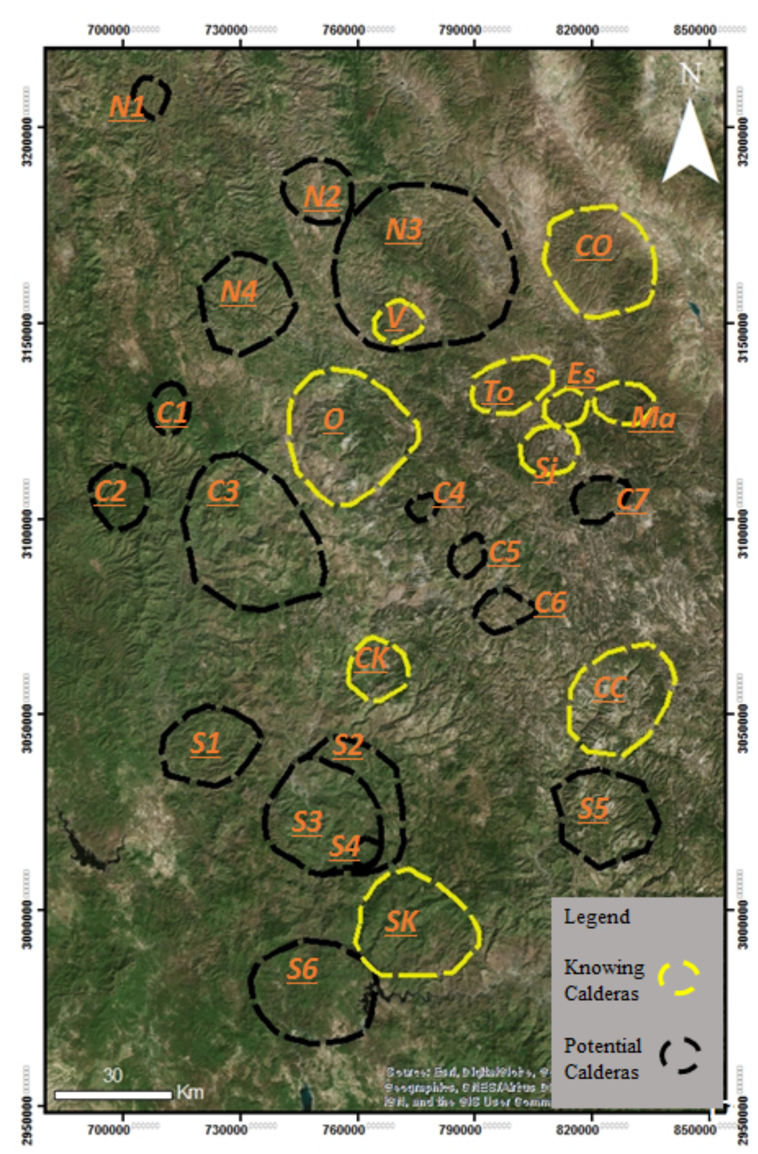

Figure 6: The map shows the knowing calderas from ((Swanson and McDowell, 1984; Wark et al., 1990; Ferrari et al., 2007; Murry et al., 2013) and the new potential calderas, and large lineaments with base map, see (Tables 3) for more details .

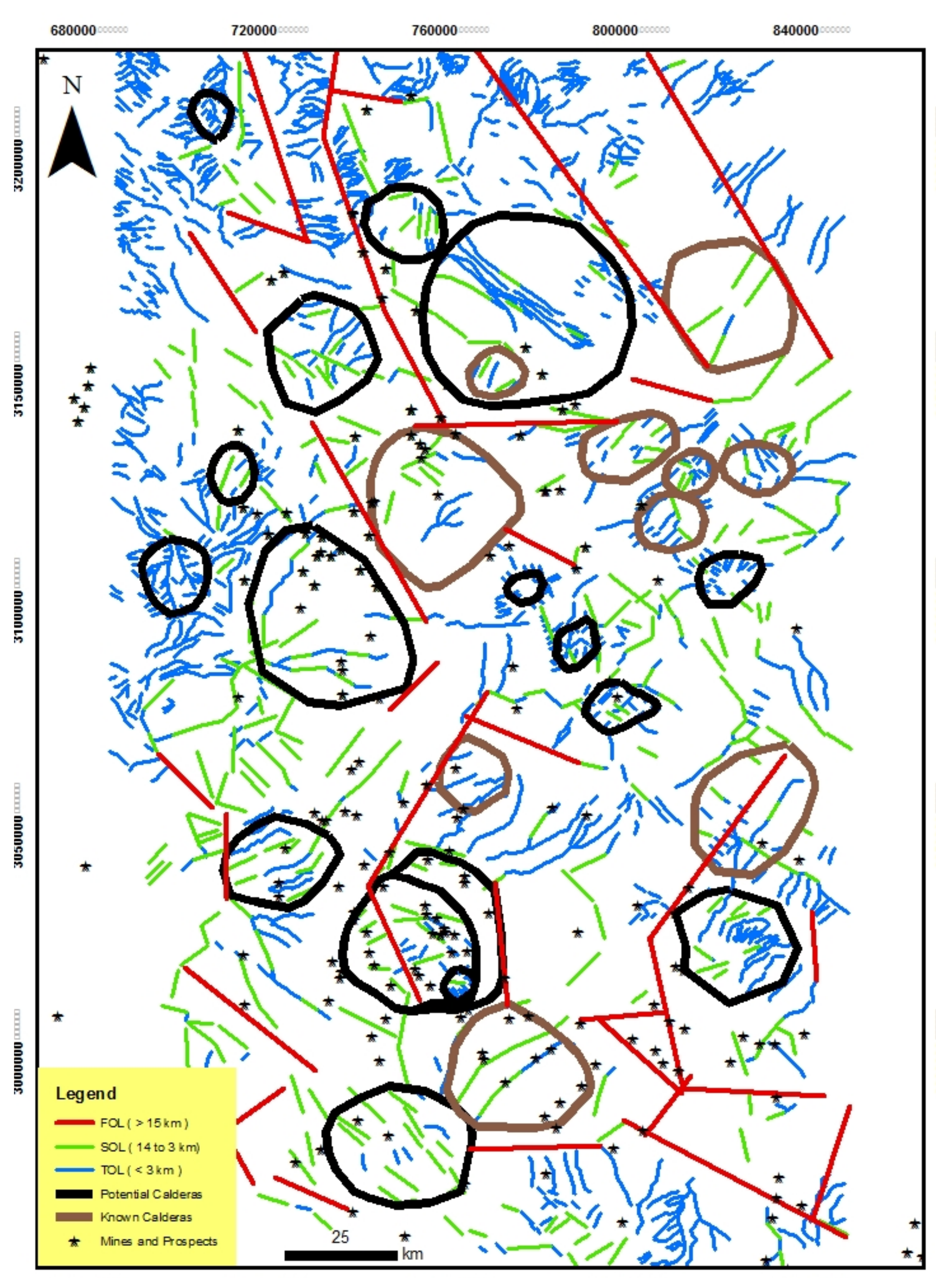

Figure 7: It shows the Frist Order Lineament (FOL), Second Order Lineament (SOL), ,Third Order Lineament (TOL), knowing calderas, potential calderas, and mines or prospects in the area of interest

Conclusions

Remote sensing has successfully helped to identify the 17 new calderas, verified 10 old ones and is in disagreement on one. Remote sensing has successfully identified 34 First Order Lineaments, which help identified horsts, grabens, and potential lateral faults. Contrast in the results between First and Third order are interpreted to represent predominately early versus late tectonic events. Mineral occurrences and mines are generally but not exclusively association with caldera rims , internal fractures and faults, radial fracture rhyolite domes, strikes slip faults features . A positive correlation exists between First Order Lineaments and occurrences. These results can be helpful for mineral exploration.

Literature cited

Swanson, E.R., and McDowell, F.W. 1984, Calderas of the Sierra Madre Occidental volcanic field western Mexico: Journal of Geophysics Research, v. 89, no. B10, p. 8787-8799.

Murray, B., Busby, C., Ferrari, L., Solari, L., 2013, Synvolcanic crustal extension during the mid-Cenezoic ignimbrite flare-up in the northern Sierra Madre Occidental, Mexico: Evidence from the Guazapares Mining District region, western Chihuahua, Geosphere, v. 9, n. 5, p. 1-35.

Wark, D.A., Kempter, K.A., and McDowell, F.W., 1990, Evolution of waning, subduction related magmatism, northern Sierra Madre Occidental, Mexico: Geological Society of America Bulletin, v. 102, p. 1555-1564.

Feinstein, M.N., 2007, Contributions to the Geology of the Cuenca de Oro: Chihuahua, Mexico: Unpublished M.Sc. thesis, El Paso, University of Texas at El Paso, 642 p., 42 maps.

Manriquez, R. 2005, Characteristics of Epithermal Gold Deposits in the North of the Sierra Madre Occidental, Mexico: Unpublished M.Sc. thesis, El Paso, University of Texas at El Paso. 328p.103p.

Goodell, P.C., 1995, Porphyry copper deposits along the Batopilas lineament, Chihuahua Mexico. Pierce, F.W., eds., Copper Deposits of the North American Cordillera: Arizona Geological Society Digest, p. 554.

Further information

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