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Remote sensing characterization of transitional to alkaline igneous rocks and their potential mineralizations using ASTER data: the Moroccan Central High Atlas case study

Youssef Ahechach[1,2], Muhammad Ouabid[1], Otmane Raji[1], Jean-Louis Bodinier[1,3], Khalid Amrouch[4], Houssa Ouali[2], and Abderrahmane Soulaimani[5]

[1]Geology & Sustainable Mining, Mohammed VI Polytechnic University, Morocco
[2]Geoscience: Géodynamique et Géoressources, Faculty of Sciences, Moulay Ismail University, Meknès, Morocco
[3]Géosciences Montpellier, Montpellier University & CNRS, Montpellier, France
[4]Australian School of Petroleum and Energy Resources, The University of Adelaide, Adelaide, South Australia 5005, Australia
[5]Dynamique de la Lithosphère et Genèse des Ressources Minérales et Energétiques, Cadi Ayyad university, B.P. 2390, Marrakech, Morocco

Alkaline complexes are an important target for geological exploration, with both scientific and economic interests. They are host to different types of mineral deposits, such as Rare Earths, igneous phosphates, -and K-rich minerals and rocks. In Morocco, the Central High-Atlas (CHA) hosts several transitional to alkaline complexes ranging from Upper Jurassic to Eocene and showing almost all the differentiation terms of transitional to alkaline suites. These alkaline complexes are however poorly explored and their potential in terms of mineral resources is still elusive.

The aim of this research is to use Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) to discriminate different transitional to alkaline rock lithologies and their associated mineralizations. For that purpose, series of band ratios proven to be sensitive to the silica, mafic, felsic and carbonate contents of transitional to alkaline rocks were applied. Our results show that the major Upper Jurassic magmatic intrusions of Moroccan CHA, such as Anemzi, Inouzane, Tassent, and Tasraft, hold distinct igneous facies, mainly composed of Mafic to felsic rocks. Field and petrographic observations have confirmed the ASTER results and highlighted that these rocks are formed of gabbro to syenite. The later are associated with significant feldspar concentrations, but also host apatite, garnet, and magnetite vein-type ores. Thereafter, field- and petrographic-based data were used as training data to perform a supervised classification allowing to refine the geological mapping of the studied alkaline intrusions.