

Litho-structural mapping is critical for resource exploration and hazard assessment, supporting economic development. This study applies Planetscope and ALOS Palsar DEM data to conduct lithological and structural mapping in the Tharaka-Kanzungo region of Kenya's Northern Kitui County. The approach integrates support vector machine classification with manual (shaded relief) and automatic (PC Line module) lineament extraction. Planetscope's high spatial resolution enabled effective rock unit discrimination, while ALOS Palsar DEM data enhanced linear-structural analysis. SVM classification achieved 76.24% accuracy and a kappa of 70%, successfully identifying lithologies such as granitoid gneiss, semi-pelitic, calc-silicate, sillimanite-biotite, hornblendite, and crystalline limestone. Comparative results showed automatic methods detected more, shorter lineaments sensitive to texture and vegetation, whereas manual extraction captured fewer, longer, and distinct orientations. Stereographic projections further revealed tectonic features including shear foliations and lineations, aiding tectonic interpretation. The dominant NE-SW and NW-SE trends indicate structural influence on fluid pathways and potential mining zones. The integration of remote sensing techniques with ground-based validation produced a high-accuracy geological map, consistent with existing data. This approach demonstrates strong potential for updating maps and guiding mineral exploration in remote or inaccessible regions.