



UNESCO Chair on
Coastal Geo-Hazard Analysis

Research Institute for Earth Sciences
Geological Survey of Iran



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Abstract

The Server-based Unified Thematic Geological Mapping (SUTGM) program is an interdisciplinary global geological research initiative that unites experts in geology, remote sensing, programming, machine learning, and artificial intelligence (AI) to capitalize on cloud computing and machine learning advancements. Its core goals are to deliver current information via integrated geological maps and to enhance the utilization of machine learning and AI in geological mapping. The program emphasizes server-based thematic mapping and cloud computing for efficient management of extensive geological datasets, employing object-based image analysis (OBIA) to precisely identify geological formations. Within the SUTGM program, AI and machine learning are pivotal in boosting the efficiency and accuracy of geological mapping. These technologies assist in processing vast geological datasets, integrating data from diverse sources, and uncovering patterns and trends that may otherwise go unnoticed. The outcomes of SUTGM comprise integrated thematic geological maps that expedite surveys, incorporate time unit legends, and notably lessen reliance on instrumental analyses. This methodology enables nationwide coverage with heightened precision and speed at reduced costs compared to traditional methods. The program's objectives include the precise rectification of satellite images, assessing the effectiveness of multispectral and hyperspectral images, and establishing a unified geoscience database. Thematic geological maps, recognized as the second generation of geological maps, provide swift and effective analyses, integrate legends and geological units, and dramatically decrease the time needed for analyzing and updating information to adhere to global standards. These maps strive to offer a quicker and more comprehensive insight into geological data, streamlining the analysis and updating of information on a global scale. Conversely, SUTGM epitomizes a contemporary approach to geological mapping that harnesses cloud-based servers for storing and processing geological data. A pilot project carried out in Iran's Lut and Makran regions successfully implemented this approach across areas spanning 30,000 km² and 5,000 km², achieving an accuracy rate $\geq 90\%$ in mapping rock units, underscoring the effectiveness of incorporating AI and machine learning in geological mapping. These studies progressed through three primary phases involving documentary and unlocking trapped data on paper, satellite imagery analysis, image processing and machine learning, and field observations adhering to a new protocol.



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