

Introduction to this special section: General submissions

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The year 2024 was an objectively great one for *The Leading Edge* (*TLE*). Besides the continuation of more-than-respectable journal metrics (see Kyle Spikes' President's Page in this issue), *TLE* also enjoyed a marked increase in manuscript submissions. With more than two weeks left in 2024 at the time of this writing, submissions were up by more than 30% compared to 2023. As *TLE* enters its 44th year of continuous publication, we hope to continue this upward trend in 2025 — a year we open with another of our popular “general submissions” issues.

In publishing general submissions issues, our goal is to provide more variety of content than one might see in a traditionally “themed” issue of *TLE*. With papers detailing onshore and offshore applications of geophysical methods, innovative uses of machine learning in interpreting and classifying geologic features, advancements in evaluating the carbon storage potential of formations, and the use of geophysical technology and methods in archaeological investigations, we hope that this issue fits the bill.

Leading off the diverse collection of technical papers gathered for this issue, Jacobsen and Knapp explore carbon storage potential in the Ivishak Formation underlying Alaska's Kuparuk oil field. Using a prestack simultaneous inversion of 3D seismic data, they identified high-porosity sands suitable for CO₂ injection. Neural networks predicted key reservoir characteristics such as porosity and shale volume, enabling 3D geobody extractions to map the extent of high-quality sands. Results revealed an environment ideal for CO₂ storage, with estimated storage capacities ranging from 1.2 to 3.8 GT.

Bao et al. examine time-lapse seismic signals, particularly “contact softening,” which occurs when softer hydrocarbons invade stiffer brine at oil-water contacts due to pressure depletion from nearby production. The findings have the potential to aid in exploration and well planning by enabling quantitative assessments of reservoir pressure depletion, characterization of unproduced hydrocarbon legs, and fluid compressibility estimates.

Through two case studies from the Sultanate of Oman, Y. Guo et al. review recent advancements in utilizing full-waveform inversion (FWI) for onshore imaging in settings with complex

near-surface geology. The authors highlight both the technical difficulties encountered and the innovative solutions applied, such as leveraging elastic FWI of surface waves and acoustic FWI to improve subsurface imaging.

L. Guo et al. introduce MS-RegNet, a deep learning model tailored for the classification of geologic features. Their approach combines multiscale feature extraction with a regulated network architecture to enhance the accuracy and efficiency of rock classification and identification. Their model achieved a classification accuracy of approximately 92% on a private data set and 94% on a public data set.

In a similar vein, La Marca et al. use synthetic reflection data built on an actual outcrop model to demonstrate how the random forest (RF) supervised machine learning method can predict deepwater channel-related seismic facies and determine how much error there is in such estimation. A simple classifier using common RF hyperparameters developed for fluid saturation predicted facies with 74% accuracy. Optimizing the RF hyperparameters provided approximately 89% accuracy, demonstrating the importance of hyperparameter tuning.

To round out the grouping of technical papers in this issue, Arvanitis and Frey take readers on a journey through time and space to Isthmia, Greece, and the Sanctuary of Poseidon — an important site throughout classical and medieval history. Here, ground-penetrating radar was employed to help identify new areas for excavation and to document unearthed components of historical significance at the site. The results, which could be used to guide future excavations in and around the sanctuary, revealed several areas of interest that align closely with historical evidence.

Introduction articles such as this typically end with a thank you to the authors, reviewers, and editors who contributed to the issue. These short notes of gratitude are prevalent to the point of becoming nearly rhetorical, but it is with the utmost sincerity that we thank all who contributed not only to this issue but to the overall success of *TLE* in the past year. That success belongs to you, and there is no doubt that it will continue in this new year. ■■■

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