AI for Deep-time Geochemistry

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Deep-time geochemistry is a critical approach to reveal Earth's evolution in geological history. With the rapid development of geochemical analytical facilities, the amount of geochemical data has been accumulated at an unprecedented rate. This trend drives scientists to mine data with new tools. Since the 1980s, the significant improvement in computation capacity has spread statistics and machine learning in geochemistry (Aitchison, 1982; Petrelli et al., 2003). Since 2010, the development of deep-time geochemical databases has allowed a series of data-driven investigations (Keller and Schoene, 2012; Keller et al., 2015). In high-temperature geochemistry with the main object of igneous rocks, the complex correlation between elements follows thermodynamic laws, while AI can effectively reveal hidden relations. For example, AI can accurately predict the evolution of magma ocean compositions (ZhangZhou et al., 2024) and indicate whether basalts are derived from subduction-related arc environments (Liu et al., 2024). In low-temperature geochemistry, with the main object of sedimentary rocks, AI can reveal clues about the evolution of the surface environment. For example, using the metal trace elements in shales, AI can reconstruct the sedimentary redox state in the geological past (Wang et al., 2023). These exciting preliminary discoveries suggest the significant potential of AI application in deep-time geochemistry. However, to fully release the potential, improving the quality and standard of data is still required to ensure data accuracy and consistency, which is essential for training AI models. Furthermore, geochemistry smart tools are still needed to enter the era of AI for the geochemistry community.

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Zoom Link (Mixed-mode)

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