Insight into the evolution of the Earth system from large geochemical databases

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Over the past two decades, large and freely-accessible geochemical and geochronological data compilations have opened new avenues for the study of the Earth system, and provided new perspectives on many longstanding problems including the onset of plate tectonics, the composition of the continental crust, and development of the Great Unconformity. Meanwhile, increasing (and increasingly parallel) computational resources have opened new avenues in modelling and inversion, in tandem with this increase in data availability. Here we will review some of the contributions in geochemistry and petrology enabled by large FAIR datasets over the 25 years since the founding of GEOROC and PetDB, and consider avenues for future work. In particular, we will consider opportunities for parallel computational techniques for both forward and inverse modelling with large geochemical datasets, and consider the opportunities as well as potential pitfalls of different statistical approaches to data analysis and machine learning in geochemistry and petrology.