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MARIMIN – A User-Friendly Tool for Rapid Mineralogical Quantification in Marine Mineral Systems

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Quantifying mineral assemblages from bulk geochemical data is essential in studies of marine mineral deposits, but is often constrained by limited sample material or the need to evaluate large numbers of samples. Established mineralogical methods such as X-ray diffraction (Rietveld refinement) and automated mineralogy (MLA/QEMSCAN) provide robust results, yet are not always feasible for high-throughput screening or very small sample volumes.

We present **MARIMIN** (Marine Minerals), a user-friendly, Python-based tool with a graphical interface for rapid estimation of modal mineralogy from bulk geochemical compositions. Model settings can be stored and reloaded, enabling reproducible analyses across large datasets. MARIMIN is designed as a complementary approach to laboratory-based mineralogical methods, providing first-order mineralogical information where conventional techniques are unavailable or impractical.

The tool targets mineral assemblages typical of seafloor massive sulfides, associated host rocks (e.g., basalts), and pelagic to hydrothermal sediments. Mineral proportions are derived using geochemical mass-balance principles combined with statistically constrained optimization. In addition to tabulated results, MARIMIN provides diagnostic outputs such as plots of dominant mineral phases, classification-style diagrams, and quality indicators (e.g., fit classes, elemental coverage) to support transparent evaluation of model results. Comparisons with independent mineralogical analyses (XRD and MLA/QEMSCAN) indicate that deviations are typically below ~10% for major mineral phases. User-adjustable controls (e.g., grouping of minerals, sequential solving strategies, and penalty functions) allow adaptation to geological context.