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Facies and environmental controls on dating carbonates using LA-ICP-MS

Marjorie Cantine[1] and Axel Gerdes[2]
[1]Goethe-Universität Frankfurt, Institut für Geowissenschaften/FIERCE, Frankfurt a. M., Germany (cantine@fierce.uni-frankfurt.de)
[2]Goethe-Universität Frankfurt, Institut für Geowissenschaften/FIERCE, Frankfurt a. M., Germany (gerdes@fierce.uni-frankfurt.de)

Carbonates make up about one-quarter of Earth's sedimentary record, and contain valuable biogeochemical records used to reconstruct Earth history. *In situ* U-Pb dating of carbonates using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) offers the possibility of dating these records directly, as well as deposition, diagenesis, and deformation. To fully assess the potential of this technique, laser ablation ages must be compared with other geochronological constraints. Geochemical (e.g., stable isotopes or trace elements) and petrographic context provide further guidance in the measurement and interpretation of carbonate-derived dates. This contribution presents case studies from our ongoing work, spanning Proterozoic and Phanerozoic samples from the marine realm, including the Neoproterozoic of Oman and Svalbard and the Cambro-Ordovician of North America. We highlight measured dates and with special focus on dating deposition and early diagenesis and integrating petrographic and geochemical data. We highlight the role of microbial mats and early marine cements in creating "datable" carbonates and discuss implications for sampling.