Combined U-Pb zircon dating and apatite trace element compositions applied to Paleozoic tephrochronology

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The global utility of a stratigraphic section that records important Earth history events requires a robust geological timescale. This could be accomplished either by establishing highly precise and accurate ages for the the section in question or by accurately correlating strata in the section of interest to those regions where a well-developed time scale has already been established. For pre-Cenozoic rocks the challenge of developing independent age constraints for any given section of rock increases with age.

An anomalously high abundance of tephra in the Late Ordovician of eastern North America and Scandinavia presents a unique opportunity to test aspects of the importance of high-precision U-Pb zircon geochronology combined with the utility of crystal-chemistry based tehprochronology. Specifically, high-precision ages combined with robust crystal chemical data can be assessed in view of its ability to help understand aspects of the Great Ordovician Biodiversification Event, end-Ordovician mass extinctions, various oceanic carbon isotope events, and the end-Ordovician glaciation. A few of the widespread tephra possibly derive from the largest known eruptions in the Phanerozoic, which may have triggered important biotic and climatic responses. Tephrostratigraphic correlation of these large eruptive units has been challenging beyond several 100's of square kilometers because the tephra are heavily altered and span different depositional and tectonic settings. Volcanogenic apatite trace element concentrations (Mg, Cl, Mn, Fe, Y, and Ce) have been successfully applied to these tephra correlation problems in the eastern U.S. and between North America and Europe. This apatite trace element tephrochronologic approach has been invaluable for investigating several chronostratigraphic schemes related to Ordovician biostratigraphy, chemostratigraphy, and sequence stratigraphy. Our new U-Pb zircon and apatite trace element data shows that there is some significant disparity in previously assumed temporal relationships, particularly between widely spaced locations.

Exoplanet atmospheres: From hot to habitable worlds

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Current observational techniques allow us to detect a broad variety of extrasolar planets. In some cases we can measure properties such as the planetary radius, mass and temperature and constrain the structure, molecular composition and dynamics of their atmospheres. The diversity of observed exoplanets is extraordinary in terms of planetary system architectures, physical conditions and chemical compositions. I will present several striking cases that illustrate this diversity.

At two extremes of the known sample of exoplanets are hot gas giants, whose atmospheres constitute a puzzle for both physicists and chemists, and potentially "habitable" worlds which, despite very exotic properties, could host liquid water. I will focus on these two types of atmospheres and show that their modeling is a challenging but extremely rich subject. I will then discuss the prospects for the next step of exoplanet characterization.