New insights into the timing and causes of the end-Triassic extinction in Southern Tethyan carbonate platforms

Francesca Falzoni*[1,2], Andrea Montanaro[2], Alessandro Iannace[2], and Mariano Parente[2]

[1]Istituto di Geologia Ambientale e Geoingegneria (IGAG), Consiglio Nazionale delle Ricerche (CNR), Milano, Italy – Italy

[2]Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università degli Studi di Napoli Federico II, Napoli, Italy – Italy

Abstract

The end-Triassic Extinction (ETE) is one of the "big five" of the Phanerozoic and severely affected shallow-water benthic calcifiers of carbonate platforms, including scleractinian corals, megalodontid bivalves, involutinid foraminifers and dasycladalean algae. This biotic crisis has been linked with volcanism of the Central Atlantic Magmatic Province (CAMP) that injected massive amounts of CO in the ocean-atmosphere system causing perturbations of the global carbon cycle, climate change, ocean acidification and anoxia. However, the timing and causes of extinctions of carbonate platform assemblages are poorly constrained owing to an incomplete stratigraphic record in the classical sections of the Northern Calcareous Alps (NCA, Austria), Transdanubian Range (Hungary) and Lombardy Basin (Italy), where the extinction level of Rhaetian taxa coincides with a facies change, evidence for subaerial exposure, sea-level drop and/or drowning.
In this study, we present new integrated biostratigraphic and inorganic carbon isotope (δ^{13}Ccarb) records of three Southern Tethyan carbonate platform sections that show continuous carbonate productivity and no evidence for a stratigraphic gap at the extinction level of Rhaetian assemblages: Mt. Messapion (Pelagonian Domain, Greece), Valle Agricola (Southern Apennines, Campania, Italy), and Mt. Sparagio (Panormide Platform, Sicily, Italy). In these sections, as observed in the composite section of the Ghalilah Fm. (United Arab Emirates: Al-Suwaidi et al., 2016; Hönig et al., 2017; Ge et al., 2018), the extinction of Rhaetian assemblages is consistently documented within the upper part of a positive δ^{13}Ccarb excursion and appears to be diachronous compared to the classical sections of the NCA, Transdanubian Range and Lombardy Basin, where extinctions are associated with a major short-lived negative shift in the organic carbon (δ^{13}Corg) record known as Initial Carbon Isotope Excursion (Initial CIE) and traditionally regarded as the onset of the end-Triassic biotic crisis.

To reconstruct the timing of the ETE in resilient Southern Tethyan carbonate platforms, we combined the δ^{13}Corg and the δ^{13}Ccarb records of biostratigraphically well-constrained sections of the NCA and Transdanubian Range, we identified four stratigraphic intervals characterized by a different (decreasing/increasing) δ^{13}Ccarb trend and we anchored each interval to ammonite stratigraphy. The obtained bio- and chemostratigraphic framework is

*Speaker

reproducible throughout the Tethyan domain and proto-North Atlantic and appears very promising for global correlations. In addition, our study suggests that, in the absence of the primary marker (i.e., the lowest occurrence of the ammonite *Psiloceras spelae tirolicum*), the position of the Triassic/Jurassic boundary can be reliably approximated using the δ^{13}Ccarb profile also in carbonate platform sections.

The resulting stratigraphic correlation between Southern Tethyan carbonate platforms and the reference sections of the NCA, Transdanubian Range and Lombardy Basin suggests that Rhaetian assemblages survived the Initial CIE in Southern Tethys, an observation that excludes the regressive phase at the top of the ammonite *Choristoceras marshi* Zone and the perturbation of the carbon cycle recorded by the Initial CIE as possible killing mechanisms at a global scale. In addition, this study suggests that the Rhaetian carbonate platform assemblages became extinct about 200 kys later in Southern Tethys, very close to the Triassic/Jurassic boundary, an interval characterized by global warming, ocean acidification and eutrophication triggered by increased continental runoff.

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Keywords: end Triassic extinction, Tethyan carbonate platforms, benthic foraminifers, global warming, ocean acidification, integrated bio and carbon isotope stratigraphy