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Constraining the fluid source of Miocene seep carbonates using radiogenic Sr isotopes (Corella outcrop, northern Apennines, Italy)

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Seep-carbonates forming close to the seafloor generally precipitate in equilibrium with the Sr isotope composition of coeval seawater (e.g. Naehr et al., 2000) and the Strontium Isotope Stratigraphy methodology (McArthur, 2001) has been recently applied to fossil seep-deposits providing reliable formation ages (Ge & Jiang, 2013; Kiel et al., 2014; 2015). Deviation from the expected 87Sr/86Sr value, possibly indicates mixing with deep fluids carrying a different isotopic signature, which can be modified during the upward migration by fluid/rock interaction (Teichert et al. 2005; Joseph et al. 2012; Torres et al. 2014).
We investigated the 87Sr/86Sr signature in a Miocene seep-carbonate body enclosed in a pelitic interval within foredeep turbidites of the northern Apennines (Corella outcrop, Italy).
Mn and Sr concentrations were measured in authigenic carbonates prior to isotope analyses for the diagenetic screening. Mn and Sr range between 35 and 236 ppm, 400 and 2306 ppm respectively, and show no correlation, thus indicating little or no diagenetic alteration. The variability in Sr values is consistent with expected original aragonite and high-Mg calcite mineralogies.
Sr isotope ratios were converted into numerical ages using the regression curves LOWESS look-up table version 5.0 (McArthur et al., 2012) and compared with nannofossil biostratigraphy of the host sediments.
Calcareous nannofossils belong to the Middle Langhian MNN5a subzone, which corresponds to an age range of ∼14.5-15.5 Ma.
The 87Sr/86Sr ratios vary within a broad range from 0.708659 to 0.709132. The corresponding numerical ages define 3 clusters: the first group includes samples ranging from 15.95 to 14.5 Ma and consistent with biostratigraphic data indicating that they carry the 87Sr/86Sr signature of coeval seawater. The second group of ages ranges from 16.90 to 16.5 Ma, slightly older than the biostratigraphic ages and these samples could be interpreted as precipitated in equilibrium with Burdigalian porewaters. A third group of samples shows remarkably more radiogenic 87Sr/86Sr ratios that correspond to converted ages between 12.00 and 1.10 Ma. We suggest that these "anomalous" values possibly represent the contribution of deep-sourced fluids that migrated upward through a fault zone interacting with thick terrigenous turbidite successions. A similar scenario has been reported at the Hydrate Ridge (deformation front of the Cascadia accretionary wedge) by Sample et al. (1993).