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Sr Isotopes at the Onset of the Ice Ages at the Northern Apennines

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Sr isotopes can be used to constrain the marine Sr budget. The temporal variations in the $^{87}Sr/^{86}Sr$ ratios (radiogenic Sr) have been reconstructed over the past few decades based on marine macro and micro fossils data (e.g. brachiopods and foraminifera). It is used to constrain the sources and amounts of strontium that dictate the temporal variations in oceanic Sr throughout the Phanerozoic. On the other hand, the study of processes controlling the composition stable Sr isotopes ($\delta^{88/86}Sr$) is very new and only limited research was conducted on this topic during the past few years. Up to date, no $\delta^{88/86}Sr$ data are available for considerable parts of Earth's history and the contribution of the potential Sr sources to the oceans is poorly constrained. Here, we set to examine the behavior of radiogenic and stable Sr isotopes in the marine environment of the northern Apennines (Italy) during the time interval of the late Pliocene to early-Middle Pleistocene – upon the onset of ice ages in the northern latitudes. We collected fossil mollusks from outcrops of the Arda and Stirone Rivers that are rich in bivalves, brachiopods, foraminifera (that were used for establishing the chronostratigraphy of the sections) and other genera. Ecological and sedimentological analysis of the section suggest a normal marine environment of depth range of several tens of meters that existed on the southern flanks of the large Po embayment. In order to evaluate the potential of the fossil assemblages in the Arda and Stirone sections to serve as reliable recorders of the marine $\delta^{88/86}Sr$ of seawater during the desired period, we examined mineralogical and chemical properties of the fossils (e.g. distribution of trace elements like Sr and Mg in the skeletons, microstructures like secondary fillings of punctate shells in brachiopod) and measured the $^{87}Sr/^{86}Sr$ ratios. Among the species analyzed, *Aequipecten opercularis* (bivalve) and *Glycymeris inflata* (bivalve) have aragonite skeletons that show normal late Pliocene - early Pleistocene marine values of $^{87}Sr/^{86}Sr$ ratios (~ 0.709). On the other hand, the calcite skeleton organisms from the same bed, *Ostrea edulis* (bivalve) and *Terebratula scillae* (brachiopod), show continental effect on the $^{87}Sr/^{86}Sr$ isotopes (values ranging from 0.7084 to 0.7089). It should be noted that these two groups of organisms have also different life styles and metabolic rates. Measuring the $\delta^{88/86}Sr$ values on the fossils with "normal" marine radiogenic Sr composition and those with continental radiogenic Sr signal may provide additional constraints on the sources and processes that affected the geochemistry of these species and yield a reliable marine $\delta^{88/86}Sr$ value for that period.