

PROVENANCE OF NEOPROTEROZOIC TO EARLY PALEOZOIC SEDIMENTARY ROCKS OF SOUTHWESTERN NEW ENGLAND

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The rare earth elements (atomic number = 57 to 71) are relatively immobile during sedimentary processes, such as weathering and diagenesis. Thus, these elements are quantitatively transferred from the source rocks into the sediment without fractionating of Sm from Nd and without resetting of the $^{147}\text{Sm} - ^{143}\text{Nd}$ isotopic system. Thus, the rare earth abundances of sedimentary rocks reflect the average composition of the source rocks. The $^{143}\text{Nd}/^{144}\text{Nd}$ isotopic ratios measured within rocks allow us to calculate the average time of mantle extraction or, in other words, the overall continental crustal residence (T_{DM}) of their provenance.

The purpose of this study is to investigate the provenance of Neoproterozoic to Early Paleozoic sedimentary rocks using their T_{DM} 's and to investigate the Nd isotopic evolution of the North American margin in southwestern New England during that time. The oldest analyzed samples are rift-related sediments which were deposited in response to extension after the Grenville orogeny (ca. 1.0 Ga). The REE abundances and patterns of these sedimentary rocks are variable and their T_{DM} 's are between 1.5 to 1.4 Ga. These rift sediments are interpreted to have localized sources and their REE abundances and Nd isotopic compositions reflect the composition of their source (i.e., Grenville crust). Younger Cambro-Ordovician pelites, dolostones and quartzites were deposited on the continental shelf during an interval of quiescence and are considered to be continental drift related sediments. Even though the depositional ages of the drift related sedimentary rocks are younger than those of the rift sediments, their T_{DM} 's are older (2.0 to 2.4 Ga). This indicates that the average provenance for these rocks was older than that for the rift sedimentary rocks. Middle Ordovician turbidites and metapelites were deposited in response to the Taconian orogeny. The Taconian orogeny is commonly described as the collision of an island arc with the North American margin. Igneous rocks associated with an active Ordovician island arc will have mantle extraction ages that are substantially younger than 1.0 Ga, approaching 450 Ma. The turbidites of the foreland basin were expected to show the addition of such juvenile material generated during the Taconian orogeny. However, the calculated T_{DM} 's for the Middle Ordovician turbidites and metapelites range from 1.7 to 1.8 Ga. These relatively old T_{DM} 's make a substantial Taconian-age source component in these sediments unlikely. This observation is corroborated by petrographic observations. No plutonic and only extremely rare volcanic rock fragments were observed which would indicated the presence of an island arc. Furthermore, U-Pb dating of detrital zircons (n=40) yielded also only old ages ranging from 1.5 to 0.9 Ga. No evidence for active Taconian age volcanism was found in the sedimentary rocks of the foreland basin.

Our data indicate that the Neoproterozoic rift related sedimentary rocks clearly reflect their derivation from Grenville crust. The Cambro-Ordovician sedimentary rocks had an older provenance probably further inland where Penokean- and Archean-age rocks can be found. The Middle Ordovician sedimentary rocks have a provenance that can be explained as a mixture of the two older sedimentary units. This mixing could be achieved via recycling of the earlier deposited rift- and drift- related sedimentary rocks in an accretionary prism before the final deposition in the foreland basin.