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Investigating the origin of Devonian 3^{rd}-order sea-level changes using oxygen isotopes of apatitic conodonts

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Phanerozoic marine successions are commonly composed of 3^{rd}-order (1-5 My) transgressive-regressive sequences which are several 10's to $\sim$100 m thick. The origin(s) of these sequences are not understood because typical orbitally driven glacio-eustatic sea-level changes have shorter durations ($\sim$20-400 Ky) and tectonically driven changes in mid-ocean ridge spreading rates are too slow to account for such sea-level changes. To begin to evaluate the origin of persistent Paleozoic 3^{rd}-order sea-level changes, we analyzed the δ^{18}O values of apatitic conodonts from Devonian 3^{rd}-order carbonate sequences from the western U.S. If the sequences were generated by climatically driven processes (glacio- or thermal-eustasy), then transgressive systems tracts (TST) and maximum flooding zones (MFZ) should record smaller δ^{18}O values then the overlying highstand systems tract (HST) and lowstand systems tract/sequence boundary (LST/SB). No such relationship should exist if tectonic processes generated the sequences.

Preliminary results from two successive and globally recognized Middle Devonian sequences (Eifelian) record a clear relationship between transgressive-regressive facies and δ^{18}O values. For both sequences, the early TSTs record higher δ^{18}O values (19.3-19.7 permil SMOW) and systematically decrease to lower values ($\sim$18.0 permil) in the late TSTs and MFZs. These values gradually increase to higher values in the HST and LST/SB (19.3-19.7 permil. These trends are consistent with a glacio-eustatic or thermo-eustatic origin for the 3^{rd}-order sea-level changes. The magnitude of isotopic shifts for both sequences range from 1 - 1.5 permil, which equates to $\geq$100 m sea-level changes or $\sim$4-7˚C seawater temperature changes. These results are particularly surprising given the apparent Middle Devonian greenhouse climate and given the subtropical paleolatitudinal position of the deposits. In addition, these results have implications for interpreting trends of longer term, secular δ^{18}O curves which may have

been sampled at lower resolution than typical thicknesses of 3^{rd}-order sequences.