Looking for the Kellwasser anoxia event in all the wrong places: the role of submarine groundwater flow (Junggar Basin, NW China)

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The Kellwasser Event at the Frasnian-Famennian (F-F) boundary in the Late Devonian is commonly represented by black shales or bituminous limestone beds with positive $\delta^{13}C$ excursions. One of the major challenges to understanding the scope of the Kellwasser Event is sample bias; approximately 88% of the studies of Late Devonian extinction and anoxia are from sites from deep epicontinental basins and epeiric seas. The Late Devonian sediments of the Wulankeshun and Boulongour Reservoir sections in the Junggar Basin in northwestern China are unusual because they represent continuous shallow-water deposition across the F-F boundary in an isolated island arc sequence [1-3]. In contrast to the positive $\delta^{13}C$ excursions found in most basinal study sites, the $\delta^{13}C$ signatures in these two sections show identical sharp negative excursions across the F-F boundary in the expected location of the Kellwasser Event, coinciding with shallow water facies. $\delta^{18}O$ values in both carbonates and conodont apatite show identical sharp negative excursions within the shallow water facies at each site, but have relatively constant signatures within the deeper water facies. $^{87}Sr/^{86}Sr$ values at the Boulongour Reservoir section range from 0.70636-0.70906 within shallow water, but also have relatively constant values in deeper water. As these sites are 100 km apart, it is unlikely that their identical isotope signatures are due to diagenetic alteration, and isotopic models, euryhaline fossil assemblages, and clastic sediment alteration textures support submarine groundwater discharge signatures rather than diagenetic alteration. In shallow water, clastic shoreline environments it may therefore be necessary to use other proxies besides positive $\delta^{13}C$ excursions and black shales to recognize the Kellwasser Event.

[1] Suttner *et al.* (2014) *J. of Asian Earth Sci.* **80**, 101-118. [2] Carmichael *et al.* (2014) *Paleo*^{3} **399**, 394-403. [3] Wang *et al*. (2016) *Paleo*^{3} **448**, 279-297.