Gold in the Ocean Through Time

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During sedimentation and diagenesis of carbonaceous shales in marine continental margin settings, gold is adsorbed from seawater and organic matter and becomes incorporated into framboidal pyrite. By measuring the gold content of sedimentary pyrite in least deformed black shales we have been able to track, in a first order sense, the gold content of the ocean through time. These data suggest that gold was enriched in the Meso- and Neoarchean oceans, several times above present values, then dropped by an order of magnitude from the first Great Oxidation Event through the Paleoproterozoic to be at a minimum, well below current levels, around 1.6 Ga. Gold content of the oceans then rose through the Mesoproterozoic and dropped again in the Neoproterozoic. Approaching the end of the Proterozoic, gold rose in steps over the period 750 to 540 Ma during the second Great Oxidation Event. In the Phanerozoic our data suggests gold had a strongly cyclical pattern with wavelengths of 50 to 150 Ma.

In the Archean and Proterozoic the gold content of seawater matches the time distribution of high Mg greenstone belts and BIFs, suggesting that increases in atmosphere oxygenation combined with the higher background of gold in komatiitic and Mg-rich basalts in greenstone belts are the first order causes of the pattern of gold enrichment in seawater. In the Phanerozoic, where komatiite-bearing greenstone belts are absent, the gold in seawater cycles continue to show a relatively good match with cycles of oxygenation of the atmosphere. This suggests that oxidative erosion of pyrite-bearing continental rocks, accompanied by increased organic productivity in the oceans, led to increased drawdown of gold into carbonaceous seafloor muds.