"Detrital pyrite" in Archean conglomerates is not evidence for an anoxic atmosphere

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Rounded grains and pebbles of pyrite (FeS_2) in gold- and uranium-rich conglomerates of Archean ages have been interpreted, mostly from their external morphology, by many researchers as detrital fragments of pyrite crystals, which were rounded during transportation in fluvial systems. They were cited as important evidence for an anoxic Archean atmosphere, because pyrite is an unstable mineral under an oxygenated atmosphere (e.g., Holland, 1994). We have investigated the morphology and composition of rounded pyrite in quartz-rich conglomerate samples from several ore horizons (~2.8Ga) in the Witwatersrand Basin using a SEM and an X-ray chemical microscope (Horiba XGT-5000).

Our investigation has revealed that: (1) both large pebbles (~10 mm) and small (0.1 – 1 mm) grains of rounded pyrite in the samples are comprised of aggregates of micro (<10 μm) pyrite crystals; (2) the rounded pyrite grains/pebbles contain appreciable amounts of Si (~0.1 - ~10 wt%), Al (~0.1 – ~5 wt%) and other rock-forming elements with highly variable ratios (e.g., Fe/S, Fe/Si); and (3) remnants of Si-rich micro layers, similar to the silica-rich laminae in banded iron formations and in jaspers, are recognizable in many large grains/pebbles of rounded pyrite. These characteristics indicate that the so-called "detrital pyrite" in Archean conglomerates was created by reactions between H_2S-rich hydrothermal fluids and detrital grains of Fe-rich rock fragments such as banded iron

formations or ferruginous cherts after the deposition of host rock sediments. Therefore, this rounded pyrite cannot be used as evidence for an anoxic atmosphere.