What Drove the Leaching of Gold from the Mesoarchen Land Surface: A Global Climate Modelling Approach

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Currently, the most plausible genetic model for the world's largest gold province, the Witwatersrand Basin in South Africa, is based on the assumption that most of the gold was leached from the Archean hinterland, then fixed by microbial mats, most of which, in turn, became mechanically reworked only to release minute gold particles to concentrate into rich paleoplacers. While this model explains neatly the spatial distribution of the conglomerate-hosted gold in the Witwatersrand, it fails to explain the stark contrast in gold endowment between the 2.96 – 2.91 Ga West Rand Group and the 2.90 – 2.78 Ga Central Rand Group. Conglomerates in the former are almost barren; those in the latter contain close to 30% of all known gold in the world. It has been shown before that prior to 2.90 Ga, chemical weathering rates were low, whereas after 2.90 Ga, they were very high, thus providing a basic precondition for the formation of the rich Witwatersrand goldfields. In this contribution, we discuss the possible causes of this drastic change in chemical weathering rates and try to assess the most important driving forces using global climate models with intermediate complexity (Planet Simulator). General agreement exists on a high concentration of free greenhouse gases in the Archean atmosphere to offset the effect of a lower solar intensity, but estimates on the surface temperature vary widely. The change in chemical weathering rates at around 2.9 Ga could be the result of global climate change, maybe triggered by rapid growth of continental crust and thus a transition from predominantly submarine to more subaerial volcanism. Alternatively, it can be also explained by the paleogeographic position of the Kaapvaal Craton, that is, its drifting from high to low latitudes.