Climate controlled the Klondike placer formation, Yukon, Canada

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The Klondike Placer District, Yukon, encompasses the variably-altered, auriferous, and quartz-veined Paleozoic chlorite-muscovite-albite Klondike Schist. Erosion of regolith in this schist through the late Miocene and Pliocene produced extensive placer deposits associated with the White Channel (WC) Gravel, which is exposed within drainages radiating from Solomon Dome. The uppermost UWC gravel interbeds with the earliest Cordilleran outwash (Klondike Gravel) in the lowermost valley reaches. The $^{26}Al/^{10}Be$ burial age of the UWC Gravel (2.64 +/- 0.20 Ma, is consistent with late Gauss Chron normal polarity and associated glass fission-track ages on volcanic glass. The WC gravel is composed of light grey to white leached and unleached braided stream sediments with a high abundance of angular milky-white quartz cobbles and pebbles, sourced mainly from quartz veins within the Klondike Schist. The lower (LWC) gravel contain pollen from which indicate an early-mid Pliocene warm period. In contrast, the upper (UWC) gravel contains syn-depositional ice-wedge casts which record cooling and appearance of permafrost during its deposition. We test the hypothesis that the disseminated gold and quartz were concentrated first in deep regolith on the dome during warm periods when slopes were transport limited, and then eroded and transported during colder or wetter weathering-limited periods. We compare the mineralogy, burial dating, and paleo-erosion rate measurements with the patterns that would be expected for a climate-controlled placer system. Our SEM mineral liberation analysis indeed reveals that the LWC gravel is more mature and quartz-rich (following intense weathering), whereas the UWC contains a mineralogy approaching the original schist with height, suggesting an inversed stratigraphy of a regolith, albeit with the possibility of unrecognized hiatuses between weathering-limited periods. Concentrations of ^{10}Be and ^{26}Al (150–850 um sieved sand fraction) are corrected for decay, and post-depositional erosion and muogenic production, to calculate the depositional concentrations and the up-section variation in paleo-erosion rate. Erosion was determined from a Klondike outwash terrace ^{10}Be depth profile with saturation concentration that limits long-term (>2 Ma) surface erosion rate to 4.5 mm/ka. From measurements in two different catchments, rates of paleo-erosion on Solomon Dome at the base of the LWC gravel were slow (transport-limited), then accelerated. Just above the contact with the UWC paleo-erosion rate was a factor of 4x slower and continued to decelerate to the top of the UWC gravel (weathering limited). Paleoclimatology, chronology, mineralogy, and paleo-erosion results indicate the Klondike placer system resulted from climate-controlled weathering and erosion and that a unique mother-lode gold source is unlikely.

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