Late glacial paleoclimate of the central Altiplano constrained by cosmogenic ^{3}He dating and 'clumped-isotope'paleothermometry

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The timing and causes of the last deglaciation in the tropical Andes are still poorly constrained. Moreover, the paleoclimatic conditions that existed in this region during the paleolake Tauca highstand between 17 and 15 ka [1, 2] are still uncertain. Here we present new cosmogenic ^{3}He ages from glacial landforms of Cerro Tunupa (20°S) showing that, in the central part of the Altiplano, glaciers persisted at their maximum position between 17 and 15 ka, and retreated synchronously with the drop of the paleolake Tauca highstand after 15 ka. This result is different from previous moraine dating [3] that indicates an earlier (~34 ka) local glacial maximum in the northern part of Altiplano. This discrepancy most likely reflects spatial variability of past precipitation. Indeed, the extent of mountain glaciers is determined both by temperatures and local precipitation.

In order to distinguish the respective effects of these two climatic variables we coupled a numerical modeling approach with an independent estimate of past air temperature based on 'clumped isotope' thermometry (measuring the abundances of ^{13}C-^{18}O bonds in carbonate minerals [4]). Modeling of glacier extent and lake level indicates that air temperatures dropped between 5.5 and 7 °C and that local precipitation increased three to four-fold during the synchronous paleoglacier and paleolake maxima in the central Altiplano (~15 ka). This cooling is consistent with the temperature change of 5±2°C inferred from clumped isotope paleothermometry applied to shallow-water biogenic carbonates of the Tauca paleolake highstand. Our reconstruction suggests that the Tauca paleolake episode (from 17 to 15 ka, during Heinrich 1 event) occurred as a result of wet and cold conditions. The presence of the lake Tauca probably induced a positive feedback on local precipitation in the central part of the Altiplano.

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Contrasting source character of gold mineralised granites in the Australian Tasmanides

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Granite-related gold deposits are an important exploration target in the Australian Tasmanides. Examples include porphyry-related (Kidston, Red Dome, Mt Leyshon), plutonic veins, greisens and non-carbonate skarns (Timbarra, Burraga, Braidwood). Intrusions range from intermediate to felsic med- to high-K calcalkaline, weakly reduced to moderately oxidised, metaluminous to weakly peraluminous "I-types" [1]. Tectonic settings range from back arc extension to post orogenic.

Nd, Sr, Hf and O isotope data for associated magmatic suites vary markedly both within deposits and regionally. The 335 Ma Kidston suite ($-8 > \varepsilon Nd > -18$) assimilated oxidised Proterozoic crust, but locally underwent "closed" system fractionation. Similar εNd ranges are recorded for the rhyolitic Red Dome suite. At Mount Leyshon ($-2 > \varepsilon Nd > -6$), early intermediate and felsic intrusions with wide ranges in εHf preceded Au-mineralised dykes which are characterised by a limited εHf (<4 εHf) range [2]. By contrast, the ~340 Ma Burraga pluton (Au-Bi) is a strongly contaminated (garnet-two mica) I-type with elevated $\delta^{18}O$ (9.4_{SMOW}). Regional granite metallogenic associations place Burraga in a SSE geographic trend of Mo–Cu, Mo–W, Au–Bi to Sn–polymetallic which compliments a magmatic trend of increasing $\delta^{18}O$, and decreasing magmatic fO_2 and εNd, consistent with the progressive assimilation of a sedimentary reductant. The 245 Ma Au–(Mo–Bi) Timbarra system represents extreme fractionation (Rb/Sr ~105), of felsic but isotopically unevolved (εNd >0) magmas.

The strong correlation between metallogenic associations and magmatic compositional character across the Au–Mo–Cu, Au–Mo–W, Au–Bi spectrum from the district to orogenic scale support a causitive (i.e. genetic) relationship between Au-dominated mineralisation and felsic magmatism. Internal variability and complexity within the systems emphasise the importance of process, in addition to source, in the generation of Au-mineralised granites.

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