Optical Dating Studies of southeastern Patagonian Sand Wedges in Chile and Argentina

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The plains of southeastern Patagonia, in Chile and Argentina, are formed mainly of sediments of multiple glaciations and basalt flows. Sand wedges, some metres deep and more than 1 m across, commonly extend downward from the surface of glacial units and represent periods of periglacial conditions of unknown age. Some dated Pleistocene basalt flows provide limiting ages on underlying or overlying glacial sediments, and hence date glacial advances. Unfortunately, most of the relevant dated volcanic rocks are early Pleistocene in age; less is known about the history of glaciation during the Middle and Late Pleistocene.

Optical dating, also known as optically stimulated luminescence dating, may help constrain the ages of these younger glacial episodes. The few optical dating studies that have been completed in southeast Patagonia have targeted lacustrine and glaciofluvial sediments of the last (OIS 2) glaciation. Since optical dating is inherently experimental, the purpose of this study was to determine an optimal dating protocol for sediments in southeast Patagonia by first dating radiocarbon-dated Holocene dune sediments at Lago Arturo. The Lago Arturo sequence contains abundant organic matter and known-aged tephra that can be used together to develop and test optical dating protocols.

Preliminary experiments to determine optical ages using the single-aliquot regenerative-dose (SAR) method were undertaken in order to find a suitable mineral and grain size for dating. Optical ages calculated from sand-size quartz are consistent with the independent age control. Most of the quartz aliquots analyzed, however, emitted very little luminescence and the signal suffered from a dominant and thermally unstable "medium component," making the use of this mineral impractical. Optical ages determined using the SAR method from silt-sized feldspar overestimated the independent ages, suggesting that the luminescence signal from this grain size fraction was only partially reset prior to burial. SAR ages calculated from sand-sized feldspar were the most promising, thus further tests were completed to determine the optimal SAR protocol for them.

Anomalous fading rates determined in this study (g = ~9%/decade) are similar to those established by other researchers working at different sites in the region. Post infrared-infrared stimulated luminescence experiments were conducted to circumvent the effect of anomalous fading, but it was found that the degree of sunlight exposure prior to burial was not sufficient to use this method. The optimal SAR protocol for sand-sized feldspar at Lago Arturo is a 200°C/10 s preheat for both the regeneration and test dose measurements, a hot (290°C) bleach step at the end of each SAR cycle to reduce recuperation, and measurement of the stimulated luminescence at 50°C.

A select number of sand wedges found throughout the region will be dated using the developed protocol. Those that yielded reliable ages dated to the last glaciation. Some sand wedges provided older optical ages, however, more testing is required to determine if these ages are accurate.