The Sedimentary Record of Deglaciation in the Western Himalaya recorded in the Indus Delta, Pakistan

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The retreat of icesheets following the end of the Last Glacial Maximum (LGM) might be expected to have caused a significant change in the nature of erosion in the Western Himalaya. We investigated the nature of this changing erosion and the stratigraphic record of the transition by drilling in the Indus delta of Pakistan. A section dating back to ~14 ka was recovered and dated by 14C AMS methods. The delta appears to have been built in two prograding stages, separated by a transgressive surface dated at around 8 ka. Curiously the delta and shoreline migrate oceanwards during the fastest stages of eustatic sealevel rise prior to 9 ka (Giosan et al. 2006). This requires strongly accelerated sediment delivery at this time, much as seen in the Bengal delta. Provenance analysis shows that this sediment is newly eroded in the Early Holocene and is not simply glacial sediments that are transported to the ocean at that time. Nd isotope analysis provides an overview of how erosion patterns change. The greatest isotopic shift is seen before ~10 ka, coincident with summer monsoon intensification (Clift et al. 2008). The direction of isotopic change is towards more continental, radiogenic values. A combination of Ar-Ar mica and single grain zircon dating indicates that the proportion of Lesser Himalayan material increases sharply at this time, largely at the expense of the Karakoram and Trans Himalaya. These more northerly ranges are still heavily glaciated and appear to have dominated the erosional flux to the delta prior to the Holocene. Glaciation was not so important in driving erosion in the western Himalaya, but may have more important in the wetter East. At the LGM glaciers did not extend much further than presently seen, largely because the climate was very arid at this time. Glaciers never covered the Lesser Himalaya, so that the pulse in erosion after 14 ka from these ranges is not due to glacial retreat. Instead we suggest that it is the intensified summer monsoon that caused both the faster overall rate and the change in the patterns of erosion. The Lesser Himalaya and the southern flanks of the Greater Himalaya are the recipients of the greatest amounts of summer rain. The fact that the Lower Holocene sediment is isotopically distinct from LGM sediment shows that reworking of older sediment is minimal. Transport times from source to the delta sink are short, at least less than the resolution of the age control (~1000 yr), as provenance and climate appear to change in parallel. However, sediment now on the seafloor of the Indus Canyon has a glacial Nd isotope character and confirms that sediment flux to the deep ocean ceased no later than the Bølling-Allerød. As a result the sediment record of Himalayan erosion preserved in the Indus Fan is buffered and lags the erosion events by at least ~10 k.y. Marine data suggest that much of the sediment now found in the delta and on the Pakistan Shelf is eroded during sealevel fall and has low preservation potential over long periods of geologic time, largely because tectonic subsidence in the delta region is now slow.

References

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