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Modeling the provenance of fine sediments in Parón Glacier Lake (Cordillera Blanca, Perú) by using a new procedure of tracer selection

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Climate warming in high altitude regions is causing rapid retreat of mountain glaciers that might likely accelerate in the near future. As much as 99 % of all tropical glaciers are in the Andes, of which approximately 70% concentrate in the Cordillera Blanca range (Perú) where Parón Lake is located at the foot of Artesonraju Glacier. In the last century the glacier surface area in the Cordillera Blanca has decreased by around one third. Melting glaciers is leading to the formation of new proglacial lakes that are increasing in number and volume playing a key role in regulating water storage and supply to glacier-fed rivers. Glacier recession results in changes in paraglacial environments where processes acting on new exposed surfaces of highly reactive rocks are highly dynamic. These processes can generate important amounts of sediments which can threaten water quality and biodiversity. Environmental concerns strengthen the need for assessing the provenance of fine sediment. To this end, in the frame of the IAEA INT5153 project a two week field survey of the Parón Lake area was carried out in October 2016 to recognize the main glacial landforms which had direct connectivity to the drainage system into the lake. The main glacial landforms, which included moraines, colluvium, glacio-fluvial terraces and alluvial fans that had developed after different stages of glacier retreat from the Last Glacial Maximum to the Little Ice Age, were mapped. For identifying the main provenance of sediments, a total of 40 composite soil and sediment samples (from 0-3cm depth) were collected as sources from representative sites on the main glacial landforms. In addition a total of 9 sediment mixtures including composite channel bed sediments and suspended sediments were collected. Channel bed mixtures were sampled along the river system between the tongue of Artesonraju Glacier and the end of Parón Lake while suspended sediment samples were also collected from the lake margin half way along its length. For applying fingerprinting methods we analysed 6 radioisotopes (2 FRNs and 4 ERNs) and a total of 28 stable elements. The preliminary unmixing results modeled with FingerPro after applying a novel procedure for tracer selection (Lizaga et al., 2020) identified different provenances in each of the sampled points depending on the proximity and connectivity of the glacial landforms. Moraines and alluvial terraces were main contributors in two of the channel mixtures while a

relatively greater apportion from colluvium and alluvial fans was found in the lake sediment mixture located at the end of the Parón Lake. Unmixing results for the suspended sediments confirmed the higher contributions from glacio-fluvial terraces and colluvium in the middle part of the lake suggesting that the direct connectivity of glacial landforms was a key control of fine sediment supply to the lake. Further research is needed to assess changes of sediment sources during wet seasons or rainfall peaks in high water and flood regime to gain more comprehensive information on the temporal and climate variability of fine sediment supply.