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New estimated Holocene denudation rates for non-glaciated areas in the southernmost Patagonian Andes (53°S), Chile

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Cenozoic denudation rates are sparsely known for the southernmost Patagonian Andes. One of the scientific approaches is to calculate long-term denudation rates based on fission track analyses. Though, these average rates comprise a long period with distinct climate conditions and very different extend of glaciation. These integrated denudation rates include extensive surface areas with different morphological, glacial and vegetational properties. In contrast, our approach is restricted to relative short Holocene periods and small catchment areas, for which the denudation and its controlling surface characteristics could be defined more precisely. Thus a more precise evaluation of the influencing parameters like climate, morphology and vegetation cover was possible. We concentrated on three restricted and nearly closed areas of denudation and accumulation. In those catchments we determined the sediment masses of lakes, based on sediment drilling, echosounding and computer based interpolation of the siliciclastic sediment masses. These masses were transferred to the denudation areas which have been characterised and measured by remote sensing.

The westernmost Tamar Lake is located on the Tamar Island in the western part of the Magellan Strait, where the annual precipitation is about 4,000 mm. The catchment area has a dense vegetation cover. The lake surrounding slopes reach an elevation of 400 m a.s.l and they are up to 60° steep. The calculated denudation rate for this catchment is about 2.56 mm/ka, which represents a minimum value, because the postglacial weathering horizon is only partly removed into the lake.

The highest elevated lake Muy Profundo (500 m a.s.l.) possesses a denudation area with a nearly vegetation-free zone up to 750 m a.s.l. within the Patagonian Batholith. The catchment area of this lake is characterised by a roche moutonnée landform with steep slopes and active fracture zones. The precipitation varies between 5,000 and 8,000 mm/a. The denudation rates of the catchment amount to 0.42 mm/ka. Despite the high precipitation and the exposed position this denudation rate is unexpectedly low. Along the active fracture zones a stronger denudation could be observed by the occurrence of restricted gullies. The removed predominantly coarse clastic material is stored in alluvial cones and not included in our mass balance.

The elevation of the catchment of the easternmost Chandler does not exceed 200 m a.s.l. and the area is characterised by a moderate relief with relatively flat slopes. The roche moutonnée landscape is interspersed with tracts of peat land and Magellanic rainforest. The precipitation ranges between 3,500 and 5,000 mm/a. Circulating acid soil water cause an intense chemical weathering and formed a 10-20 cm thick weathering horizon at the interface between bedrock and peaty soil. Due to the sediment core and the echosound stratigraphy, the denudation could be determined for two periods of time. The 2,040 cal. a BP tephra layer of the Mt. Burney volcano is the most distinct reflector in the echosound data. Therefore it was used as a sedimentation boundary. The denudation rates for the period 12,100 to ∼2,000 and for the last 2000 years are very similar with ∼2.55 mm/ka.

On the basis of e.g. Ti/U enrichment in the weathering horizon, we conclude that the chemical denudation is very important in areas with vegetation cover in the superhumid Andes. In a long-term perspective, the relatively high denudation rates of low elevated peat land compared to the exposed rock surfaces may further increase the relief even during interglacial periods, like the Holocene. On the basis of our results we could state that the precipitation plays only a subordinated role as a control mechanism concerning the denudation in ice-free, but low

temperate areas of the Patagonian Andes.