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Modern and subrecent spatial distribution and characteristics of sediment infill controlled by internal depositional dynamics, Laguna Potrok Aike (southern Patagonia, Argentina)

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Situated in the dry steppe environment of south-eastern Patagonia the 100 m deep and max. 770 ka old maar lake Laguna Potrok Aike (51°58'S, 70°23'W) has a high potential as a palaeolimnological key site for the reconstruction of terrestrial palaeoclimate conditions. As this area is sensitive to variations in southern hemispheric wind and pressure systems the lake holds a unique lacustrine record of palaeoclimatic and palaeoecological variability. Depositional changes inferred from the lacustrine sediment sequence as well as subaerial and subaquatic lake level terraces provide detailed information about the water budget of the lake related to the variability of the Southern Hemispheric Westerlies. For this reason the lake was chosen as an ICDP drilling site in 2008 within the "Potrok Aike maar lake sediment archive drilling project" (PASADO). Based on high resolution multi-proxy investigations of the last 16,000 years carried out on a 18.9 m long sediment record (Haberzettl et al., 2007; Mayr et al., 2009; Wille et al., 2007) this study focuses on the understanding of internal depositional dynamics which control the characteristics and spatial distribution of the sediment infill of this lake. Furthermore, it provides information improving the accuracy of the interpretation of the long sediment record recovered within the PASADO project.
A survey of the spatial sediment distribution was carried out in 2005 using 46 gravity cores of up to 49 cm length covering a range of water depths from 9 to 100 m. All 46 cores were scanned with X-ray fluorescence technique and for magnetic susceptibility with up to 1 mm spatial resolution. Using Ca and Ti as well as magnetic susceptibility data the cores were correlated and linked to the established age model (Haberzettl et al., 2005). As these parameters vary considerably and not consistently within the suite of littoral cores, a correlation prior to the 2005 sediment surface is solely based on cores from water depths exceeding 45 m. Thus, samples of the surface sediments were taken from all 46 cores while sub-sampling of selected time intervals - AD 1960, 1800, 1610, 1500, 1380 - was only possible for up to 26 well correlated cores from the deep central basin. These time slices cover palaeoenvironmental distinctive intervals representing different hydrological settings (Haberzettl et al., 2005). Geochemical, sedimentological, palynological, diatomological, and stable isotope data were used to produce distribution maps for all these parameters and for every time slice by kriging methods.
Results of the surficial sediments, i.e. representing the last 20 years of the record, confirm pronounced differences between the littoral cores and the lake's profundal cores separated from each other by steep slopes. Modern sedimentation patterns point to distinct internal depositional dynamics induced by the dominant westerly winds. At the eastern shore frequent erosion, resuspension and redistribution of littoral sediment is followed by transport to a profundal accumulation area. Hence, sedimentation within this terminal lake is not only influenced by lake level changes, episodic inflows and the surrounding geology but also by wind driven wave action and resulting internal currents.
The subrecent spatial sediment distribution is evaluated and interpreted in the context of these modern processes. Changing wind patterns and varying lake levels are assumed to cause modifications of depositional dynamics and affect the varying palaeo-shoreline proximity to the analysed sediment cores during the selected late Holocene time sections. Comparable to modern patterns intensified sediment redistribution at the eastern shore is observed

during the post-Little Ice Age (AD 1960) comprising a low lake level and strengthened winds. In contrast, Little Ice Age (AD 1800) conditions of a lake level high stand and less intense westerly winds result in a more homogeneous sediment distribution within the deep central basin. Nonetheless, these homogenous patterns indicate distinct variations over time as several tributaries and the north-eastern outflow become influencing variables of the sediment distribution.

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