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Sedimentary environment and volcaniclastic sedimentation in a caldera lake,the Akakura caldera in the Kurikoma geothermal area

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The Pleistocene Kan-nodai Formation was deposited in the collapse basin formed by felsic volcanism of the Akakura caldera, South Kurikoma geothermal area, northeast Japan. The middle and upper members of the formation represent postcaldera lacustrine deposits, which accumulated within a closed caldera lake. Based on grain size, composition and sedimentary structure, nine lithofacies are defined in the lacustrine deposits, which are arranged into two categories: epiclastic facies and volcanic facies. The epiclastic facies contains (1) graded breccia, (2) disorganized breccia, (3) interbedded sandstone and mudstone, (4) massive mudstone, (5) graded mudstone, and (6) laminated mudstone. The volcanic facies consists of (1) graded pumice tuff, (2) bedded fine tuff and (3) andesitic sandstone and mudstone.

Based on the combinations of the epiclastic facies, two facies associations are defined: slope apron facies association and basin plain facies association. The slope apron facies association is composed predominantly of the interbedded sandstone and mudstone together with the graded breccia and the disorganized breccia, which is characterized by the laterally continuities of beds, the lack of systematic vertical depositional pattern and the absence of distinctive erosional features. Dominant sedimentary processes are high- and low-density turbidity currents and debris flows. The soft-sediment deformation structures considered as products of slump and fluidization are common features. The slump was presumably attributed to high rates of sediment accumulations of turbidites and debris flow deposits on relatively high slope gradient. Palaeocurrent direction represents from outside of the caldera to basin center and appears to reflect multiple sources rather than a major single source, indicating that the sediments were originated from the caldera wall bounding the caldera lake without a substantial fluvial input. The turbidity currents and debris flows probably result from the slope failures (rockfall, slide, slump) on such caldera wall.

In contrast, the basin plain facies association, which overlies the slope apron facies association, consists of the graded mudstone, the massive mudstone and the laminated mudstone with abundant plant fossils. The depositional processes are dominated by fine-grained sediment gravity flows such as dilute turbidity currents and debris flows, and suspension fallout. Laterally continuous sharp beds without large-scale erosional base, and the lack of load cast and flame structure are common features, indicating deposition in a low-energy setting.

The environmental change from the slope apron to basin plain is likely to reflect the retrogradational fill that result from (1) the retreat of the caldera wall due to erosional processes such as slope failures, and (2) the rise of lake level due to accumulation of water within caldera lake. Indeed, there is no evidence for significant fall of the lake level such as large-scale erosional features in the lacustrine sequences.

Sedimentary environments and depositional processes in the lake of the Akakura caldera are similar to those of general slope apron and basin plain depositional system in an open ocean. However, the deposits at the slope apron and basin plain environments of this study are noteworthy in that voluminous volcanic facies generated by postcaldera volcanism at southeastern part within the caldera basin are laid down. Such postcaldera volcanism was characterized by explosive eruption producing a large amount of the felsic pyroclastic materials and the effusive eruption producing the andesite coherent lava and associated volcaniclastics. The lacustrine sedimentation within the Akakura caldera was strongly influenced by the postcaldera volcanism in addition to erosional processes of the caldera wall.