Rara Lake, its bathymetric feature and origin, Jumla District, western Nepal Himalayas

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Introduction

Bathymetric survey of Rara Lake that is the largest lake in Nepal Himalayas was carried out in September 2009, using an ultra sonic sounder and GPS and clarified bathymetric feature of the lake and the depth.

Bathymetric feature of Rara Lake and its surrounding terrain

Rara Lake is situated in the western end of the wide rhomboid-shaped valley that opens to the east. Water elevation is approximately 2980 meters a.s.l. Its surrounding mountain is ranging from 3200 meters a.s.l. in the south to 3700-3900 meters a.s.l. in the north and southwest. The lowest is eastern part (Fig.1). Eastern bank of the lake is shut by low relief hills of less than 50m above the lake level. It looks like an embankment of a natural dam of which scale is only 500m in width and is1.3km in length. The coastline of Rara Lake is just adjacent to the piedmont line except its southwest corner, where an alluvial fan develops. The alluvial fan is dislocated by a active fault that shows down-throw of eastern side of the fan surface.

The bathymetry of the lake is quite converse to that of the terrestrial topography. The bathymetry of the western half of the Rara Lake is box-shaped with a flat bottom deeper than -160 meters below the lake level

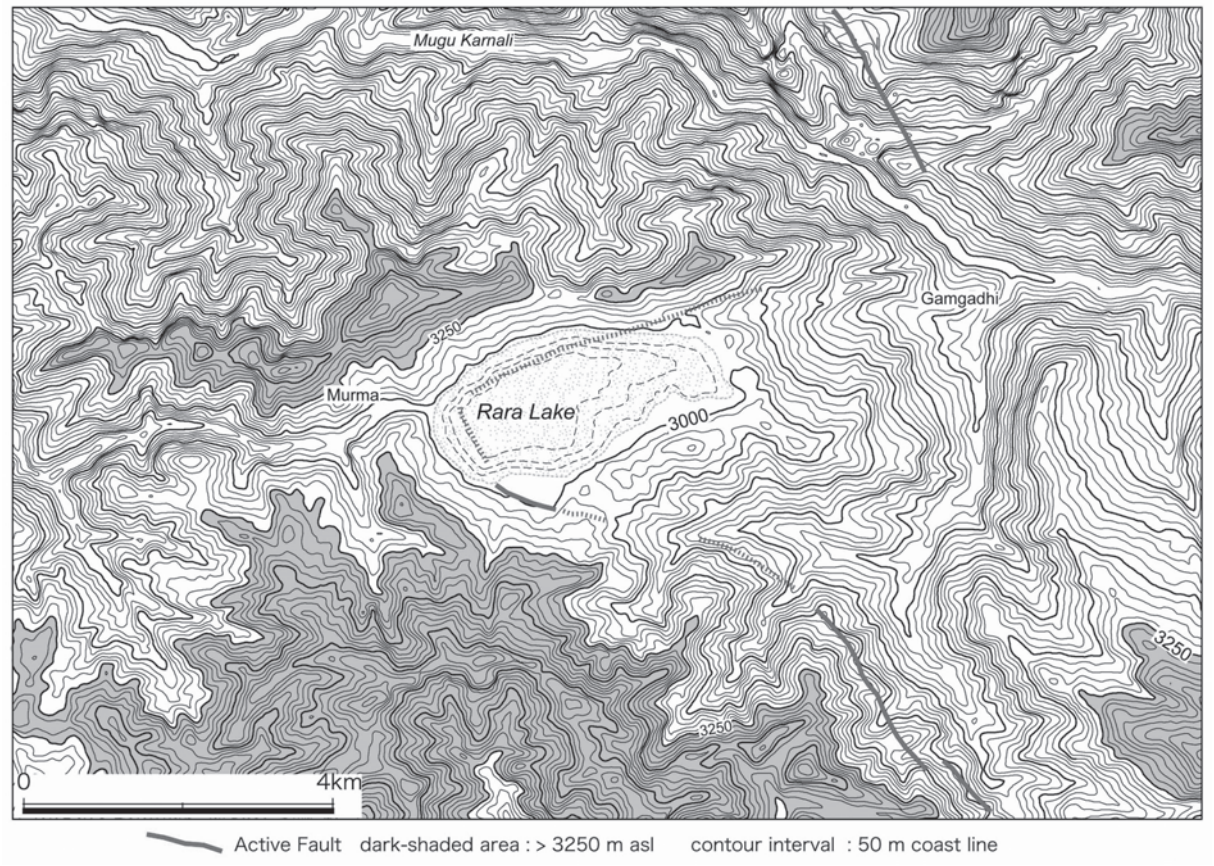

Figure 1　Topography around Rara Lake

Topographic map was generated from GDEM. Contour interval : 50 meter

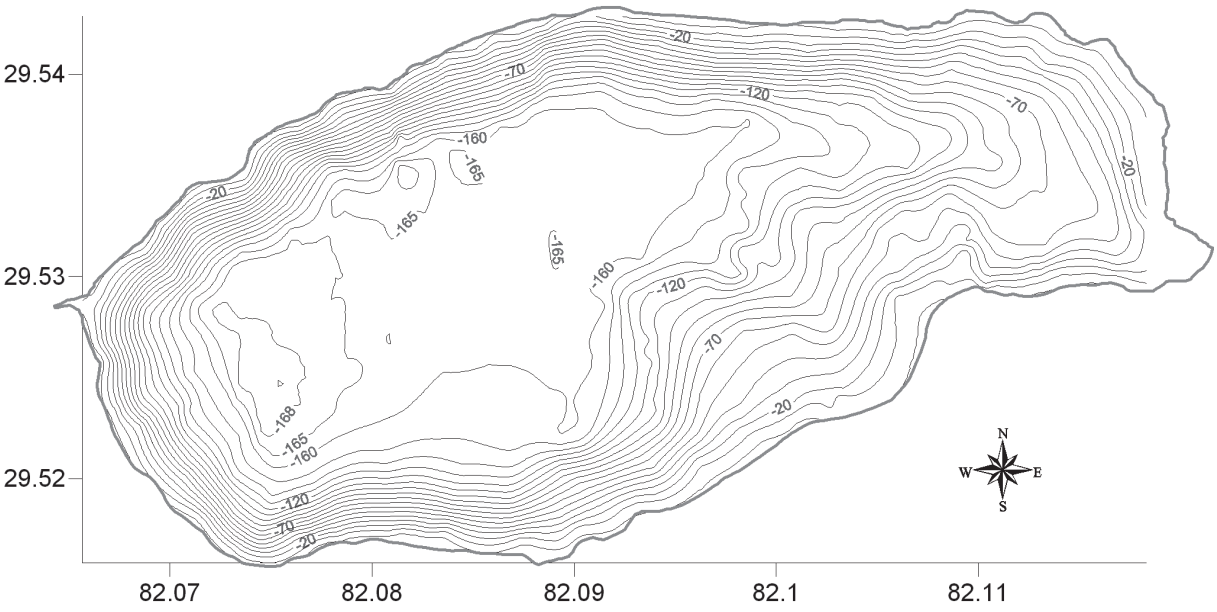

Figure 2　Bathymetry of Rara Lake made by hydrographic survery

though the transverse profile of its eastern half shows V-shaped submerged valley (Fig.2). A western margin of the lake is bounded by a steep submerged cliff deeper than 160 meters. Such steep and straight cliffs develop also in the northern and southern side. However, its eastern part is gently declining to the west.

The deepest part of the bathymetry of Rara Lake, forming a trapezium-shaped depression lower than -168 meter below the lake level, locates just adjacent to the submerged steep cliff fringing the western end of the lake. The deepest point measured by the study is -169 meters below the lake level on 10th Sept. 2009, so calibrated depth of this lake is deeper than -168 meter at least because the lake level was only 34cm higher than the mean level. We call this deepest point as the Rathour Deep after Major Susil Singh Rathour, the respectful commander of Nepal Army stationed at the Rara Lake camp.

Origin of Rara Lake

Present outlet of the lake is situated at the northwestern corner of the lake and a shallow stream incises the bedrock. So the submerged wall located along the western fringe of the lake consists of the bedrock not of detritus.

Fluvial system in this watershed could flow to the east from the west because of the topographic outline in vicinity of this lake, though the bathymetry shows westward deepening. Such bathymetric and terrestrial topographies in the western part of Rara Lake can not be explained by the fluvial system. Because water flow only to the lower side and incises a V-shaped valley or a gorge and the river floor decreases the elevation downward.

The eastern bank of the lake is fringed by narrow embankment composed of the detritus thicker than 100meters. Consequently, it is very clear that blockage of the mouse of the rhomboid valley has primarily formed Rara Lake due to detritus embankment. The detritus consists of fine sediments and blocks. However, the detritus is not landslide origin, because the bathymetry of the eastern half of the lake does not shows landslide topography consisted of a cluster of mounds and hollows and there are no arcuate steep scarps on surrounding mountain slope which imply development of landslides. Supply of detritus as another possibility is attributed to glacial advance, but there are no obvious glacial geomorphology in the last glacial age such as cirques or U-shaped valleys in surrounding mountains below 3700m a.s.l. The detritus was drifted from far distance by the larger glacial advance prior to the last glacial age.

It becomes a matter of discussion how the rectangular box-shaped depression in the western end has been formed. The alluvial fan is cut by the active fault that down-threw its eastern side. The active fault is northwestern extension of the Talphi fault (Nakata 1982; Nakata *et al*. 1984) that is one segment of the active fault system with dextral displacement along the Main Central Thrust and that steps its trace to Darma Fault (Kumahara and Nakata 2005) in the north of Rara Lake.

The trace of the active fault clearly continues northwestward to the submerged steep wall of the western fringe of the lake. That implies western half of the lake is tectonic origin due to pull parting that is liable to occur at a step of active faults. Namely, the box-shaped depression located in the western half of Rara Lake has been formed as a pull-apart basin at the step of a series of the dextral active fault, Simikot-Talphi active fault system.

Thus Rara Lake presumably has been formed due to multi causative processes, pull-apart at the step of the dextral active faults and detritus embankment of the mouse of the depression due to paleo-glaciation.

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