ETUDE DES SEDIMENTS QUATERNAIRES, DE LA MOLASSE ET SA TECTONIQUE, DANS LE GRAND LAC (LEMAN) A PARTIR DE DONNEES SISMIQUES 2D ET 3D

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During the last few years the Institute of Geophysics of the University of Lausanne developed a 2D and 3D high-resolution multichannel seismic reflection acquisition system. The objective of the present work was to carry on this development while improving our knowledge of the geology under Lake Geneva, in particular by studying the configuration of the large accidents affecting the Tertiary Molasse that makes up the basement of most Quaternary deposits.

In its 2D configuration, our system makes it possible to acquire seismic profiles with a CDP interval of 1.25 m. The fold varies from 6 to 18 depending on the number of traces and the shooting interval. Our air gun (15/15 cu. In.) provides a vertical resolution of 1.25 m and a maximum penetration depth of approximately 300 m under water bottom. We acquired more than 400 km of 2D sections in the Grand Lac and the Haut Lac between October 2000 and July 2004.

A 3D seismic survey off the city of Evian provided data on a surface of 442.5 m x 1450 m (0.64 km2). Ship's navigation as well as hydrophone and source positioning were carried out with differential GPS. The seismic data were processed following a conventional sequence without applying AGC and using post-stack migration.

The interpretation of the pre-Quaternary substratum is based on sismofacies, on their relationships with terrestrial geological units and on some borehole data. We thus obtained a map of the geological units in the Grand Lac. We defined the location of the subalpine thrust from Lausanne, on the north shore, to the Sciez Basin, on the south shore. Within the Molasse de Plateau, we identified the already know Pontarlier and St Cergue tranforms Fault as well as faults. We mapped faults that affect subalpine Molasse as well as the thrust fault plane between alpine flysch and Molasse near the Lake's south shore. A new tectonic map of the Lake Geneva region could thus be drawn up. The substratum does not show faults indicating a tectonic origin for the Lake Geneva Basin. However, we suggest that the orientation of glacial erosion, and thus the shape of Lake Geneva, was influenced by the presence of faults in the pre-Quaternary basement.

The analysis of Quaternary sediments enabled us to draw up maps of various discontinuities or internal units. The top pre-Quaternary basement map shows channels of glacial origin, the deepest of them reaching an altitude of 200 m a.s.l. The channel's slopes are directed to the North-East, in opposite direction of the present water flow. We explain this observation by the presence of artesian subglacial water circulation. Glacial sediments, the maximum thickness of which reaches 150 m in the central part of the lake, record several glacial recurrences. In the Evian area, we found lenses of glacio-lacustrine sediments set high up on the flank of the Lake Geneva Bassin. We correlated these units with on-land borehole data and concluded that they represent the lower complex of the Evian sedimentary pile. The lower complex is older than 30 000 years, and it could be a Kame deposit associated with a periglacial lake. Our 3D seismic reflexion survey enables us to specify the supply direction of detrital material in this unit. With detailed seismic images we established how some units were affected by different erosion types.

The lacustrine sediments we imaged in Lake Geneva are thicker than 225 m and 400 m or more under the Rhône Delta. They indicate several depositional mechanisms. Their base is a major turbidite, thirty meters thick on average, that spreads between the Dranse mouth and the Rhône delta. Above this unit, settling of suspended biological and detrital particles provides most of the sediments. In the eastern part of the lake, detrital contribution from the Rhône builds a delta that progrades to the west and imbricates with the settling sediments. The shallow structure of the Rhône Delta abruptly evolved, probably after the catastrophic Tauredunum event (563 A.D.). It probably coincides with an erosive surface that we mapped. As a result, the delta geometry changed, in particular associated with a displacement of water bottom channels. In all our seismic sections, we do not observe fault in the Quaternary sediments that would attest postglacial tectonic activity in the basement.