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Seismic Modeling of the Alasehir Graben, Western Turkey

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The purpose of this study is to develop a depth model to make synthetic seismic reflection sections, such as stacked and migrated sections with different velocity models. The study area is east-west trending Alasehir graben which is one of the most prominent structure in the western Anatolia, proved to have geothermal energy potential by researchers and exploration companies.

Geological formations were taken from Alaşehir-1 borehole drilled by Turkish Petroleum Corporation (Çiftçi, 2007) and seismic interval velocities were taken from check-shots in the same borehole (Kolenoğlu-Demircioğlu, 2009). The most important structure is the master graben bounding fault (MGBF) in the southern margin of the Alasehir graben. Another main structure is the northern bounding fault called the antithetic fault of the MGBF with high angle normal fault characteristic. MGBF is a crucial contact between sedimentary cover and the metamorphic basement. From basement to the surface, five different stratigraphic units constitute graben fill . All the sedimentary units thicknesses get thinner from the southern margin to the northern margin of the Alasehir graben displaying roll-over geometry.

A commercial seismic data software was used during modeling. In the first step, a 2D velocity/depth model was defined. Ray tracing was carried out with diffraction option to produce the reflection travel times. The reflection coefficients were calculated and wavelet shaping was carried out by means of band-pass filtering. Finally synthetic stacked section of the Alasehir graben was obtained. Then, migrated sections were generated with different velocity models. From interval velocities, average and RMS velocities were calculated for the formation entires to test how the general features of the geological model may change against different seismic models after the migration. Post-stack time migration method was used. Pseudo-velocity analysis was applied at selected CDP locations. In theory, seismic migration moves events to their correct spatial locations and collapse energy from diffractions back to their scattering points. This features of migration can be distinguished in the migrated sections. When interval velocities used, all the diffractions are removed and fault planes can be seen clearly. When average velocities used, MGBF plane extends to greater depths. Additionally, slope angles and locations of antithetic faults in the northern margin of the graben changes. When RMS velocities used, a migrated section was obtained for which to make an interpretation was quite hard, especially for the main structures along the northern margin and reflections related to formations.