

PRECASPIAN AND SOUTH CASPIAN BASINS: SUBSIDENCE EVOLUTION OF TWO SUPERDEEP BASINS

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The Precaspian (PCB) and South Caspian (SCB) basins are two superdeep basins containing around 20 kilometers of sediments. PCB is situated to the north of the Caspian Sea (Fig. 1) mainly on land, and has been trapped at the border of the East-European Platform with the closure of the Urals ocean during Carboniferous. It is also influenced by the repercussions of Tethys closure during Cenozoic, with the Caucasus compression to the south-west. SCB is surrounded by compressional structures and is trapped in an intermediate position between the Caucasus and Kopet Dag belts, bordered to the south by the Iranian block with the Alborz belt.

PCB contains about 20 km of clastic and carbonates sediments deposited since perhaps as old as the Riphean. It comprises a 4 km salt layer of Kungurian age (lower Permian). Salt movements produce numerous salt structures which prevent a precise analysis of the post salt subsidence. The basin is underlain by a thin crust (less than 10 km) of high seismic velocity. Its origin is still a controversy; it could be either thinned continental or oceanic crust. At the base of the crust, a 10 km layer of velocity 8-8.1 km/s is recognized by seismic and gravity observations. Is it a part of crust or mantle? These hypotheses have a direct implication on the modeling of the subsidence evolution.

The SCB is also filled by 20 km of sediments but much more recent as the oldest sediments seem to be of Jurassic age. The thickness of the Plio-Quaternary section is beyond 10 km, deposited in a very rapidly subsiding basin. A consequence of the rapid sedimentation is the undercompaction of sediments too rapidly buried, allowing the development of mud volcanoes. The crust in the central part of the SCB is thin (8-10 km) with high velocities around 6.6-7 km/s.

Both basins were submitted to a complex geodynamical history with polyphased rifting and periods of compression. The origin and a great part of the evolution of the basins take place in a continental rifting context with crustal thinning (either Riphean to Devonian for the PCB or Jurassic-Cretaceous for the SCB). It is followed by the formation of a sub-oceanic or oceanic crust at least probably in the SCB. At least for some periods of their history, the extension took place in a position of back-arc extension, not reaching total opening. Thus the basins are underlain by a thin, high velocity crust which answers rigidly (with a strong mechanical behavior), by an increase of subsidence, to subsequent phases of compression. It leads to an acceleration of the subsidence during probably the late Carboniferous and Pliocene-Quaternary for the PCB and early Pliocene for the SCB, explaining its especially high subsidence rate during a very short time.

Modelling of the two basins has been undertaken in the frame of the international Peri-Tethys Programme. The geodynamics of these two thick basins are compared by the mean of the subsidence analysis. Backstripping of sedimentary columns (synthetic subsidence curves in the center of the basins, Fig. 2) and along regional cross sections allow to characterize the subsidence evolution of each basin with its different extensional and compressive phases, alternating with periods of thermal relaxation. Models of crustal thinning and oceanic crust emplacement allow to explain the amount of subsidence during the rifting and thermal post-rift phases. Then models of elastic bending due to compression, combining gravity data and rheological assumptions, allow to fit the increase of subsidence observed during the compressional phases. Gravity models permit also to check the presence of a thin high velocity crust below the basins of around 20 km of sediments but of very different ages and evolution.

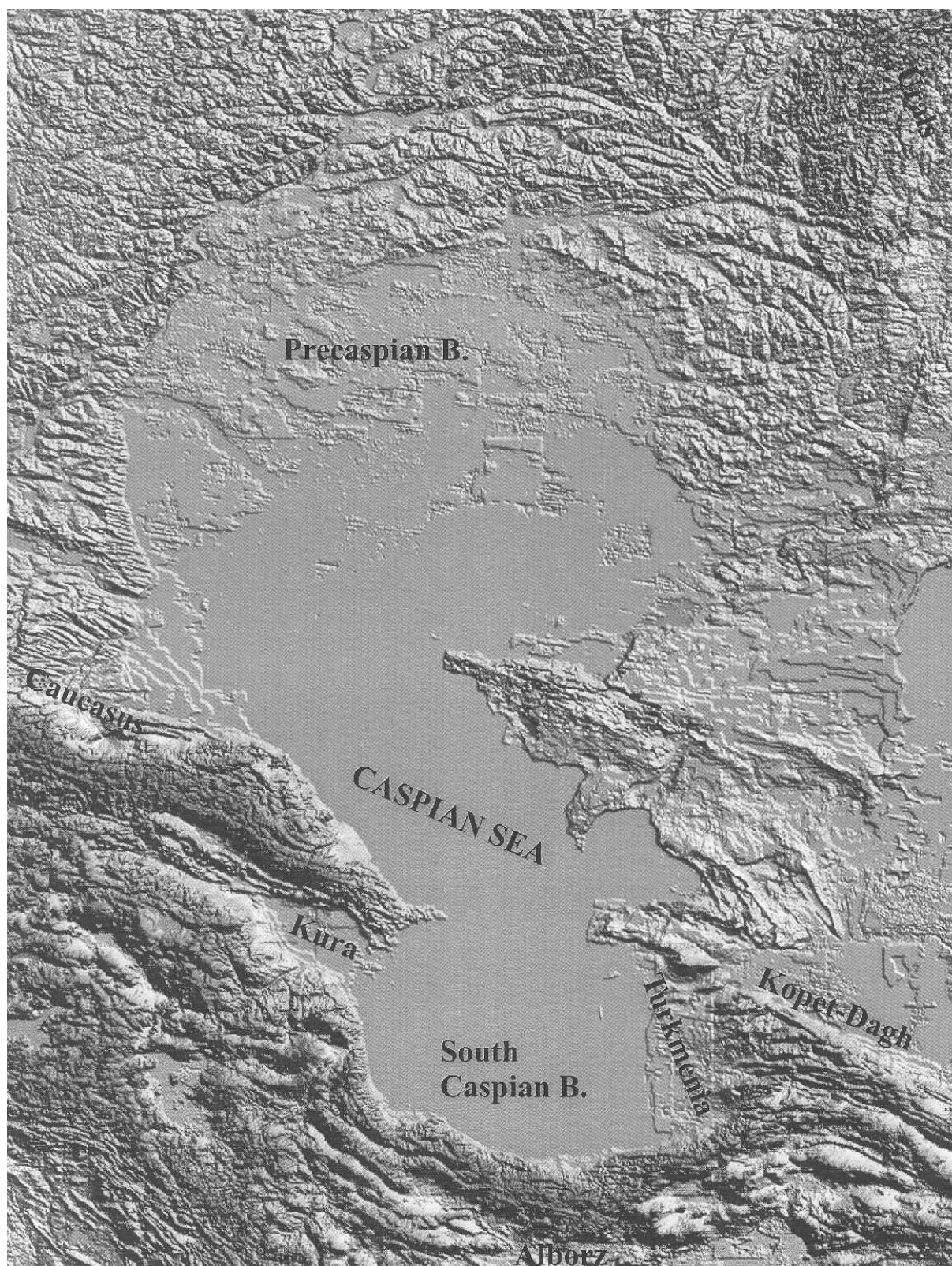


Figure 1. Regional frame.

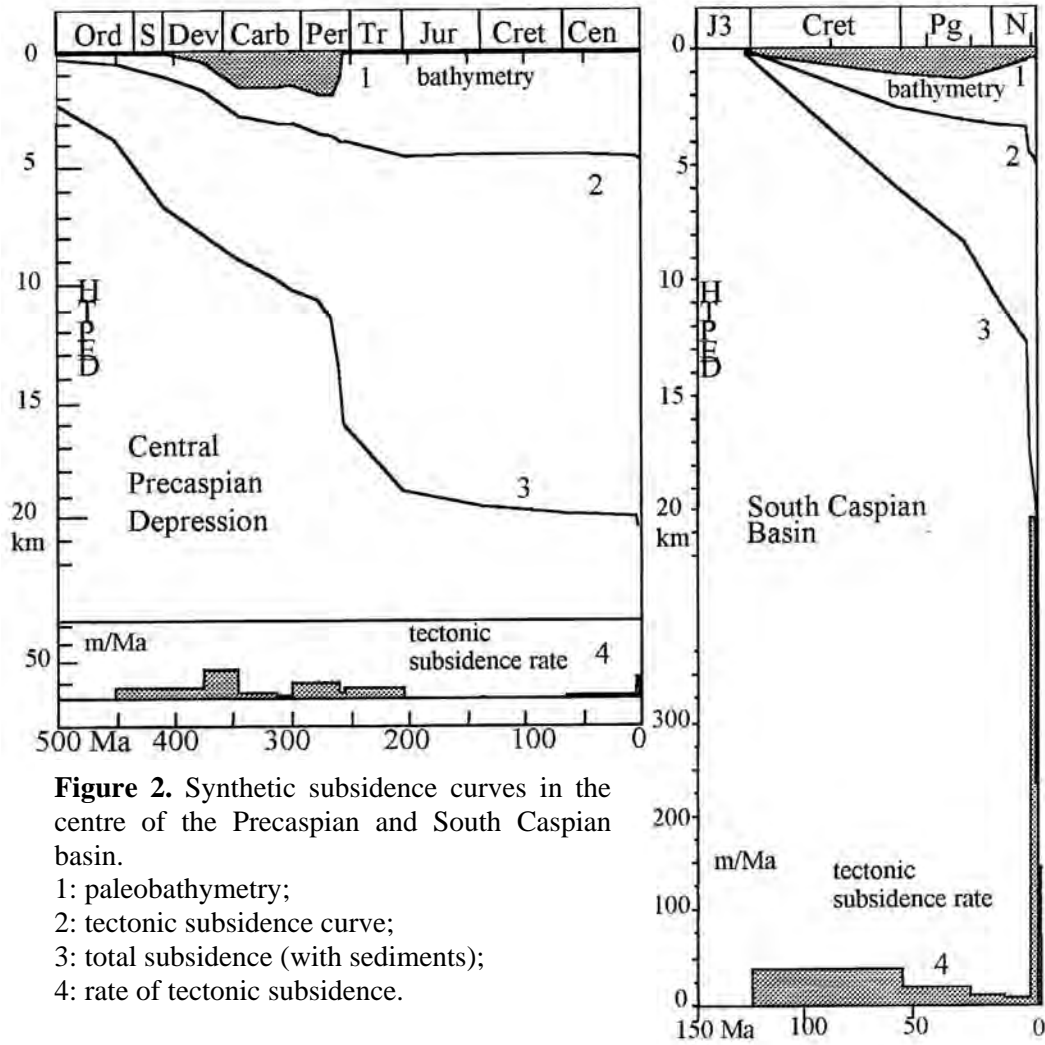


Figure 2. Synthetic subsidence curves in the centre of the Precaspian and South Caspian basin.

- 1: paleobathymetry;
- 2: tectonic subsidence curve;
- 3: total subsidence (with sediments);
- 4: rate of tectonic subsidence.