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Tethyan Belt Trona and Borate Deposits: An Overview

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The Tethyan Belt hosts some of the largest trona and borate deposits in the world. These deposits are confined to a small area extending from western Anatolia to Serbia, deposited in lacustrine basins from the middle Eocene to middle Miocene. All of the trona deposits in the world, except for the Kazan trona, were discovered during oil or coal exploration programs. The Kazan trona deposit was discovered by using geologic exploration criteria such as pseudomorphs, depositional setting of the lacustrine systems, basin analysis, and other tools.

Tectonic setting is very critical for both trona and borates. Trona is precipitated in two distinctive tectonic settings—rift basins and foreland basins. Foreland basins host all of the known fossil deposits. Both the Kazan (45 Ma) and Beypazarı (21.5 Ma) trona deposits were precipitated in closed playa systems characterized by very extensive mud flats around the lake and contemporaneous volcanism. The extremely low gradient in the basin feeds the saline crystals to the playa center during the wet season.

Formation of Tethyan and North American borate deposits was associated with the contemporaneous opening of asthenospheric windows, the Farallon slab in North America (termination of subduction of the Farallon plate off the coast of California and the volcanic/tectonic change to a transform plate boundary), and detachment of the Tethyan slab from the lithosphere, which sank into the mantle in western Turkey. By contrast, other parts of the Tethyan Belt and Canadian Cordillera remained intact and did suffer a major orogenic collapse. Tearing of the slab is similar to tearing a paper, and volcanism clearly dates the direction (such as from south to north in the southwest US or east to west in Turkey). The initial borate deposits in both cases were sodic and followed by Ca borates. The age of Kırka is 20.8 Ma, and Jarandol, Emet, Bigadiç, and Karliovassi have ages of 18.3, 16.8, 15.7, and 8.6 Ma, respectively. Just before deposition of Kırka borate, Beypazarı trona and associated Na carbonate minerals were formed by evaporation in a playa system in the Beypazarı area (21.5 Ma). Similarly, the age of the Boron deposit in California is 19 Ma.

Saline sections in the field with dissolution zones (such as pseudomorphs and/or molds), or supergene saline crystals, help in the identification of both borate and trona deposits.