MINERALOGY, GEOCHEMISTRY, AND GENESIS OF SEPIOLITE AND PALYGORSKITE IN NEOGENE LACUSTRINE SEDIMENTS, ESKİŞEHİR PROVINCE, WEST CENTRAL ANATOLIA, TURKEY

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Abstract—Sepiolite and palygorskite are common as layers and nodules in the Neogene lacustrine sediments of the Eskisehir area. This study aims to determine their mineralogical and geochemical characteristics, plus the distribution of these economically important sepiolite and palygorskite deposits within the lacustrine environment. Using these data the research goes on to discuss the environmental conditions for their formation. Sepiolite and palygorskite layers are associated with dolomite, marlstone, and argillaceous limestone. The sepiolite nodules (meerschaum), which are former magnesite gravels, are observed in the Upper Miocene reddish-brown fluvial deposits derived from the ophiolite and its fracture-infills at the northern margin of the basin. Sepiolite and palygorskite are only sparsely associated with dolomite and accessory magnesite, quartz, feldspar, and amphibole. Sepiolite and palygorskite fibers formed as oriented platy fan, interwoven, and knitted aggregates in the absence of dolomite indicated precipitation from supersaturated solution. Sepiolite and palygorskite fibers edging dolomite crystals postdate dolomite and formed through precipitation in a vadose environment under semi-arid to arid climatic conditions. High values of Mg+Fe+Ni and enrichment of light rare earth elements (LREE) relative to middle rare earth elements (MREE) and heavy rare earth elements (HREE), Sr content, depletion of Rb+Ba and K, and negligible negative Eu anomalies all reflect the derivation from the Paleozoic metamorphic and Upper Cretaceous ophiolitic rocks. Locally, Upper Miocene to Lower Pliocene volcanic, volcanoclastic, and fluvio-lacustrine sedimentary rocks supplied the required Si, Mg, Al, and Fe for precipitation of Al-sepiolite and Mg-palygorskite with average structural formulae of Si11.91Al0.09O30Mg6.60Al0.78Fe0.13(\(OH\))2Na0.12K0.06(\(OH\))\(_4\)·nH\(_2\)O and Si12.02O30Mg7.87Fe0.01(OH)\(_4\)Na0.13K0.03(OH)\(_2\)\(_4\)·nH\(_2\)O, respectively. In contrast to the layered sepiolites, the absence of Al and high Ni content in sepiolite nodules suggest formation through replacement of magnesite gravels at shallow burial in an alkaline environment. The calculated meerschaum sepiolite chemical formula is: Si12.02O30Mg7.87Fe0.01(OH)\(_4\)Na0.12K0.06(OH)\(_2\)\(_4\)·nH\(_2\)O.

Key Words—Argillaceous Carbonate, Dolomite, Eskisehir, Meerschaum Sepiolite, Neogene, Palygorskite, Sepiolite, Turkey.

INTRODUCTION

Sepiolite deposits in the Eskisehir province (west central Anatolia) have been known since the 18th century (Irkeç and Gençoğlu, 1993; Ecė and Çoban, 1994; Ecė, 1998; Kadir et al., 2002, 2010; Karakaya et al., 2004, 2011; Yeniyol, 2012, 2014), while sepiolite nodules (meerschaum) have been exploited in Anatolia since ancient times (Bilgen, 2006). Meerschaum sepiolite has physical properties that have made it a valued material for the carving of highly decorative and lustrous smoking pipes and ornaments.

Sepiolite nodules and layers associated with dolomite are overlain by Lower Pliocene gypsum-bearing dolomite in the lacustrine sediments (Akıncı, 1967). Sepiolite and palygorskite layers are brown, beige, and white in color. The darkness of the layers depends on the relative abundance of sepiolite ± palygorskite, organic material, and dolomite content (Fukushima and Shimosaka, 1987; Irkeç, 1987–1988). Sepiolite and palygorskite precipitated from lake (Singer, 1984, 1989; Rodas et al., 1994; Galán and Pozo, 2011) and/or interstitial waters between magnesian silicate precursors and dolomitic sediments under saline, alkaline (pH 8.0–9.5), and low pCO\(_2\) conditions during early diagenesis (Jones and Galán, 1988; Akbulut and Kadir, 2003).

Palygorskite is commonly formed from aluminous-magnesian smectitic precursors or through precipitation from solution in lacustrine-palustrine, ephemeral-playa environments, paleosols, and calcretes (Jones and Galán, 1988; Eren et al., 2004, 2008; Kadir and Eren, 2008; Kaplan et al., 2014; among others) under shallow evaporitic conditions associated with carbonate, sulfate, and rarely phosphate minerals (Singer and Norrish, 1974; Post, 1978; Singer, 1979; Galán and Ferrero, 1982; Singer, 1984; Shadfan et al., 1985; Yeniyol, 1986; Jones and Galán, 1988; Irkeç and Ünlü, 1993; Suárez et