Origin of late Cretaceous phosphorites in Egypt

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Late Certaceous phosphorites in Egypt form a part of the extensive Middle East-North Africa phosphogenic province. Although most previous studies consider the phosphate as authigenic, its origin is controversial. Phosphatic grains are mainly composed of bioclasts and structureless grains with minor lithoclasts. Presence of detrital grains and phosphatic bioclasts fragments within some phosphatic lithoclasts, similarity between the matrix of phosphatic lithoclasts and structureless grains, and absence of true oolite suggest that the phosphatic grains are of reworked origin. Similarity in the surface texture of structureless phosphatic grains and the authigenic phosphate beds in Israel suggests that the phosphatic grains could be derived from the authigenic phosphorite beds.

Middle East to North Africa phosphogenic province of late Cretaceous to Paleogene age contains the greatest amount of phosphorites in the geological history, possibly in excess of 70 billion metric tons. The phosphatic deposits in Egypt, called the Duwi Formation, forms a part of this province and its phosphate resources exceed 3 billion metric tons. Although most previous studies consider the phosphate as authigenic, its origin is controversial. The object of this study is to examine the origin of the Egyptian phosphorites through detailed petrographic, mineralogical and chemical analyses.

The Duwi Formation comformably overlies non-marine varicolored shale of the Qusseir Formation, and comformably overlain by marine laminated gray foramineferal-rich shale of the Dakhla Formation. Duwi Formation is divided into three members. The productive beds occur in two horizons, which are separated by montmorillonite-rich shale of the middle member. Productive beds, which used to be considered as the same horizon, occur in the lower member at Abu-Tartur area and in the upper member at Nile Valley and Red Sea areas. One common feature of the Duwi phosphorites is the extensive bioturbation. As a result, most of the phosphatic beds appear massive.

Petrographically, the phosphorites of Egypt are composed of phosphatic grains, non-phosphatic grains, cements, and pores. Phosphatic grains are composed of bioclasts, structureless grains, and lithoclasts. Phosphatic lithoclasts are composed of structureless phosphatic matrix in which small amount of detrital quartz or bone fragments are scattered. Bioclasts constitute up to 60 0n volume of total phosphatic grains and their contents increase to the E-NE.

EPMA analysis confirmed that the structureless grains are homogeneous and don't posses any concentric structure. It is also proved that the Egyptian phosphorites of upper horizon are similar in composition to the Jordanian phosphorites.

SEM observation of the surface of structureless phosphatic grains indicated that they have the similar surface texture as the primary phosphorite beds in Israel.

Presence of phosphatic lithoclasts of reworked origin, presence of phosphatic bioclasts fragments within some of the phosphatic lithoclasts, similarity between the matrix of reworked phosphatic grains and structureless grains, and absence of true oolite and phosphatic cement suggest that both the bioclasts and structureless phosphatic grains are reworked from pre-existed authigenic phosphorite beds.

Above EPMA analysis and SEM observation suggest that the phosphatic grains of the Egyptian phosphorites could be derived from the primary authigenic phosphorite beds in the Campanian Meshash Formation in Israel. The westward increase in roundness and sorting and the decrease in content of bioclasts, grain size and lithoclasts may support the eastward source of the phosphatic grains. This is consistent with the expected paleocurrent system during Cretaceous that was characterized by westward flow.