Occurrence of Glauconites in the Paleogene Succession of Kutch and their Stratigraphic Implications*

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Extended Abstract

Presence of glauconites suggest low sedimentation rate and therefore glauconites are considered to be one of the key elements in sequence stratigraphy. The Paleogene sedimentary succession of Kutch represents a platformal carbonate with several glauconite beds. The paleoenvironmental settings and stratigraphic implications of these glauconites are explored in the present work based on integrated sedimentological, micropaleontological, and geochemical investigations. The succession comprises of Naredi Formation, Harudi Formation, Fulra Limestone, and Maniyara Fort Formation from bottom to top. Glauconites are found in all the formations although their mode of occurrence, mineralogy and maturity (expressed as K_2O and Fe_2O_3 content and darkness of glauconite peloids) are different.

The glauconites of Naredi Formation occur at the lower part which is characterized by alternations of green shale and red shale. In this formation the feldspars and faecal pellets are found glauconitized. The foraminiferal assemblage of the green shale comprises of *Guembelitria*, *Chiloguembelina*, small *Globigerines,* and *Globorotalids*. The red shale, on the contrary is barren of foraminifera. The foraminiferal assemblage suggests deposition of the green shale in midshelf depositional settings while the intervening red shale suggests deposition in supratidal conditions. Glauconites mostly occur as rounded to sub-rounded peloids. It has been observed that the glauconites are most mature when the basin experienced maximum flooding. Glauconites are almost absent in the overall shallowing, upper part of Naredi Formation, characterized by Assilina–bearing limestone.

In the Harudi Formation, the glauconite grains are found in the upper part in green shale facies. Foraminiferal assemblages of the Harudi Formation suggest a paralic depositional setting for the lower part where some ill-preserved miliolids and rare juvenile rotalids are found. In the green shale facies the foraminiferal assemblage is made of the species of *Guembelitria*, *Globigerina, Nummulites*, *Quinquelculina*, *Cibicides*, *Florilus,* and *Bulimina*. The occurrence of glauconite coincides with a rapid rise of relative

sea level at this horizon. The glauconites occur either as infillings of bioclasts or as peloids. In this bioclast, glauconites occupy the chambers and canal system of benthic foraminifera. It is the common and predominant mode of occurrence. The second type of bioclast infilling occupies the open voids such as carapaces of ostracoda, Bryozoa, and gastropoda. Glauconite peloids and infillings form separate clusters respectively in a cross plot involving K_2O and Fe_2O_3 plot. K_2O as well as Fe_2O_3 content of the glauconite peloids are higher than the infillings. The peloids corresponds to evolved type while chamber infilling represent nascent type of glauconites. The glauconite pellets, however, represent alteration of clay minerals, possibly related to faecal pellets. The top of the Harudi Formation represents maximum paleobathymetry as well as the maturity of the glauconite pellets. Mature glauconite formation was facilitated by extremely low rate of sedimentation close to the maximum flooding surface.

In the overlying Fulra Limestone glauconites occur as immature authigenic and reworked pellets. Glauconites are found mainly at the lower part of the Fulra Limestone. This part of the formation marked the deposition of fossiliferous and frequently cross-stratified limestone. The immature glauconites within the foraminifer chambers possibly suggest relatively higher rate of sedimentation compared to the previous case in Harudi Formation.

In the basal member of the Maniyara Fort Formation glauconites occur in the green shale and fossiliferous limestone. Here the glauconite minerals occur in two different forms such as glauconitized faecal pellets and infilling within the foraminifer chamber. In case of the chamber filling types, chambers of foraminifera test are filled by light brown glauconite. Glauconitized faecal pellets are richer in K_2O and total Fe_2O_3 compared to the bioclasts. On the other hand, Al_2O_3, MgO, and CaO content of glauconites related to bioclasts are higher compared to those of the faecal pellets. The formation was deposited in inner shelf and the maximum bathymetry, as revealed by the foraminiferal assemblages of *Nummulites*, *Operculina,* and *Lepidocyclina*, is marked by the presence of glauconitic limestone. The peak occurrence of glauconite, however, is just below the level of maximum bathymetry in the green shale part which lies in a deepening upward sea level.

Although glauconites are associated with maximum flooding in the basin, these are also found within the deepening upward sedimentary succession. Glauconites of the former type are found to be more matured compared to those occurring within the deepening upward sedimentary succession.