It may be argued that in Kutch, the sea remained stationed or transgressed off and on from Jurassic onwards, i.e., up to Pliocene times, resulting in the accumulation of Tertiary strata over the Jurassic rocks. Thereafter, the post-Jurassic sediments were eroded away and, during the process, their foraminifera leaked into the underlying Jurassic strata. If this were so, one should expect at least some remnants of post-Jurassic sediments over the Jurassic rocks, but none have been observed so far. The post-Jurassic elements of foraminifera are confined to the weathered outcrops only. The compact samples are free from them. The possibility of leaking from the once overlying post-Jurassic rocks therefore can be ruled out.

Kutch is bounded by beaches on the western and southern margins and marine Tertiary rocks are developed and well-exposed in its northwestern part. As discussed earlier, the post-Jurassic elements show perfectly rounded and abraded tests and exhibit the characters of wind-borne sediments. It is most likely that during summer months when strong westerly winds and dust storms prevail in this arid region, the post-Jurassic foraminifera along with other material, were blown from the western and northwestern parts of Kutch and sprayed over the Jurassic exposures present in the eastern sector. Thereafter, they impregnated the Jurassic sediments through percolating water during rainy season and got entombed in the sediments as 'leaked' material.

This explains the presence of post-Jurassic elements of foraminifera in the Jurassic rocks of Kutch. This association may also occur at other Jurassic exposures in the region and great caution is required in the interpretation of age, palaeoecology and correlation of Jurassic rocks based on foraminifera and other microfossils.

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GENETIC CLASSIFICATION OF MATRIX OF PANCHET SANDSTONES, RANIGANJ COALFIELD, WEST BENGAL

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Introduction: Correct estimation of amount of matrix deposited as clastics during sedimentation helps in understanding the hydrodynamic picture of deposition. Panchet sediments have been subjected to diverse diagenetic activity. The original water-worn boundary of the sand sized clastics are affected imparting corroded margins to the latter and in extreme cases, the sand grains are totally masked or replaced by diagenetic products. Compaction of softer particles between competent clastics producing a new packing mode of greater stability under a thick pile of sediments and their subsequent chemical degradation leads to the appearance of matix which was not originally present during sedimentation. Failure to recognise these additions leads to the gross overestimation of matrix content and is likely to give superfluous result on hydrodynamic interpretation and textural classification. Correct estimation of matrix is also hindered when profuse calcite replacement has taken place—a common feature within the Panchet Formation.

The difficulties outlined above in estimating the true amount of matrix deposited as clastics points to the need for a genetic classification of matrices of Panchet sandstones. Dickinson (1970) in his classical work on the interstitial constituents of sandstones identified diverse types of matrix. This has been adopted to construct a model for classification of matrices of Panchet sandstones.

TABLE I

GENETIC CLASSIFICATION OF MATRIX OF PANCHET SANDSTONES

1. *Primary Origin:*
   (i) Deposited as clastics during sedimentation.
      (a) Protomatrix.

2. *Secondary Origin:*
   (i) Formed by diagenesis
      (a) Epimatrix
      (b) Orthomatrix
   (ii) Formed by mechanical deformation of soft clastics and diagenetic alteration afterward.
      (a) Pseudomatrix

Description: Protomatrix (Fig. 1). This type of matrix in Panchet sandstone consists of unrecrystallised randomly oriented brown ferruginous clayey lutum in weakly consolidated rocks. This variety of matrix was deposited during sedimentation and free from diagenetic activity.

Epimatrix (Fig. 2): This involves the epigenetic replacement of sand-sized materials. Chlorite neoformed in matrix of Panchet sandstones under high diagnetic grade is found to produce intercrystalline intergrowth (Dapples, 1972) with quartz and feldspar. During deep burial stage the environment became reducing and the pore fluid was alkaline, rich in Ca and Mg; the considerable thickness of the overburden also registered a rise in pressure and temperature. The combined effect of these factors caused the formation of chlorite. Complete or partial dissolution of quartz due to reaction with alkaline solution under high temperature provided room for accommodation of simultaneously precipitated chlorite in the rock framework. In the case of complete replacement original grain boundary is difficult to make out but it can be recognised only when relicts or faint outlines are present in the chloritic matrix.

Orthomatrix (Fig. 3): In this form interstitial clay particles are thoroughly recrystallised. During recrystallisation, previous clay materials reconstituted as platelets are oriented radially on the preexisting clastic surface. The clay platelets occurring in contact with mineral interfaces are coarse and elongate but become finer as the distance of the platelets from mineral interface increases. During recrystallisation, the preexisting clastics acted as foundation (nucleus) to control the process but at places underwent subsequent replacement by the aggrading clay platelets. The

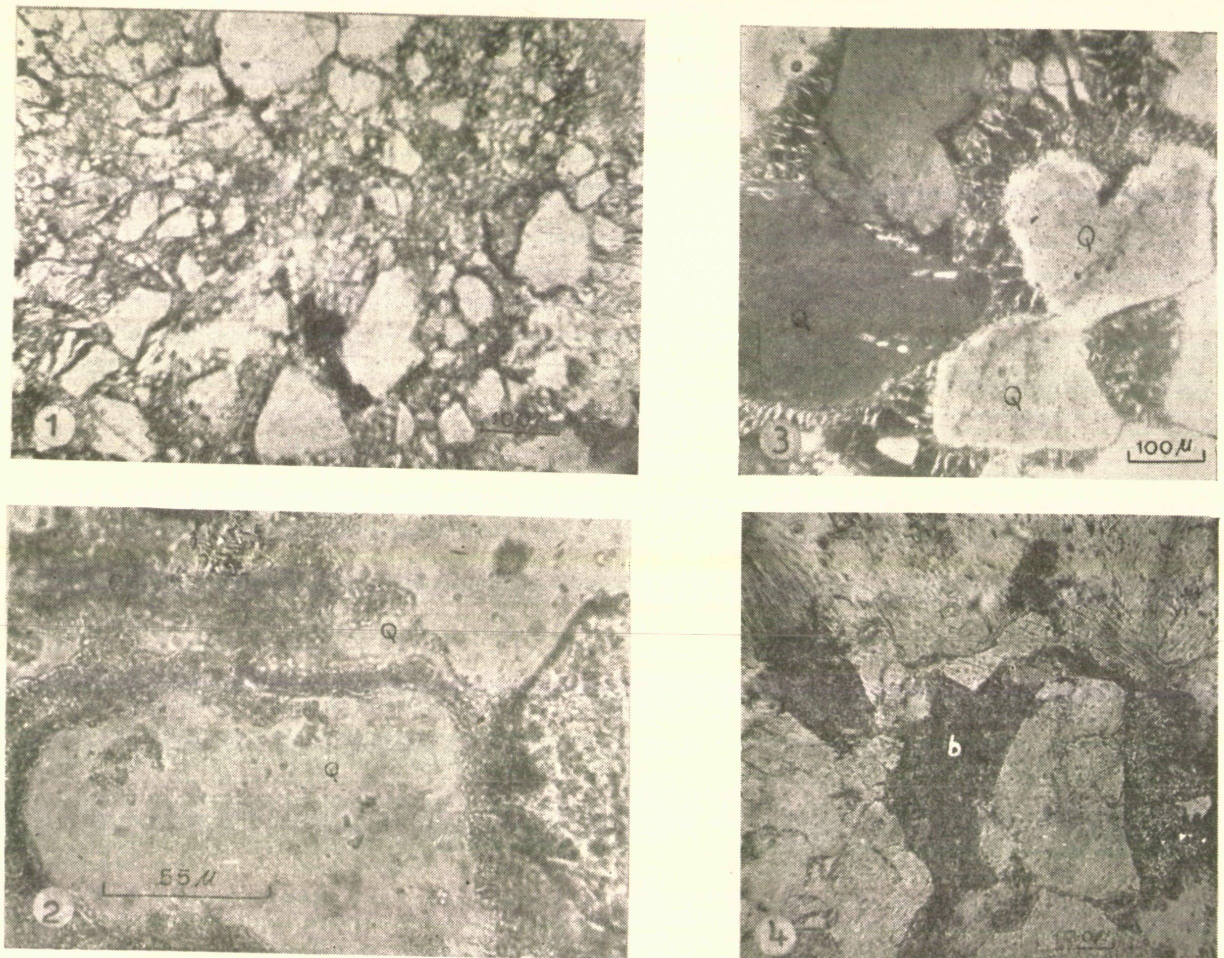

Figure 1. Protomatrix: Primary matrix is free from any secondary replacement (Bar in the corner of the photograph represents magnification). 2. Epimatrix: Partial replacement of quartz (Q) by chlorite (c). The replaced parts of quartz have a tendency to grade into matrix. 3. Orthomatrix: Interstitial clay is thoroughly recrystallised. The clay platelets are oriented radially around the preexisting quartz grains (Q). 4. Pseudomatrix: Clastic biotite (b) is replaced by chlorite. Traces of cleavage are seen and the outlines of the biotite are almost lost between quartz grains.

recrystallised clay matrix may be confused with structures attained by pore space precipitation but their gradation to protomatrix through intermediate phases confirm their formation by recrystallisation.

Pseudomatrix (Fig. 4): The term pseudomatrix introduced here for discontinuous interstitial paste formed in response to mechanical deformation of weak detrital grains (biotite) against competent clastics (quartz). Before compaction, the softer and harder clastics remained side by side. In the first stage of pseudoplastic flow and with the expulsion of free water, the margins of softer clastics were compressed against the boundary of stronger clastics and gradually the outlines of the former began to disappear; with further increase of pressure biotite assumed irregular attenuated shapes occupying volumes interstitial to rigid grains. Chloritization transformed the pseudomatrix patches to the forms of more or less continuous chlorite paste between the clastics.

Discussion: Different textural and compositional modifications of rock frameworks leading to the development of different types of matrices give an idea about the progressive diagenetic changes of the Panchet sediments.

Pseudomatrix was formed in an early stage of cementation where softer clastics were deformed between harder clastics under hydroplastic condition and later, the pseudomatrix patches were chloritised in reducing environment aided by elevated pressure and temperature under influence of advanced stage of diagenesis. Authigenic origin for chlorite in Panchet sediment is evident from its radial growth around preexisting quartz nuclei. Irregular and jagged outlines of quartz and feldspar in epimatrix regions must have been developed due to diagenetic etching by chlorite, otherwise the forms with such irregular embayments if inherited from source, could not stand against the wear and tear of transportation. Compositionally, the orthomatrix in Panchet sandstones, is a mixture of sericite and interwoven silica. Precipitation of chert and neoformation of micaceous minerals in the rock framework is considered to be characteristic of intermediate and particularly late stage of diagenetic grade (Dapples, 1959).

Formation of ortho- and pseudomatrix signify an addition of extra amount of matrix in the rock framework which was not present during sedimentation. Sometimes, masking of clastics by aggrading clay platelets also give rise to the formation of an additional amount of matrix. Hence for textural and hydrodynamic interpretation indiscriminate incorporation of these secondary matrices may produce erroneous result.

The secondary matrices and the diagenetic etching or dissolution marks on clastics can only be detected from thin sections. Hence determination of grain size of Panchet sandstones should be done from thin sections and no sandstone should be selected for the said analysis where the matrix is other than protomatrix.

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