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Petrology of the Siliciclastic rocks around Surgutaria (S.E. of Joda) Keonjhar District, Orissa

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Abstract

Siliciclastic rocks around Surgutaria village are mature to sub-mature quartz-arenites to quartz-wackes. Quartz-wackes are produced due to extensive readjustment of sericite-chert matrix during phyllomorphic stage of development in the arenite frame work. Various statistical parameters, and current structures clearly reveal that the deposition of siliciclastics took place in a stable shallow marine to tidal flat environment.

Introduction

The Precambrian rocks exposed around Surgutaria (85°27′, 21°59′) village, 1.5 kilometers S.E. of Joda, Keonjhar district, belong to two stratigraphic horizons namely, the older Iron Ore Formation and the younger Kolhan Formation (Dunn, 1940; Misra, 1961). The lithological units of the Iron Ore Formation are silicified shale, brecciated quartzite, banded hematite jasper, iron manganese ores, whereas the siliciclastics namely, conglomerates and sandstones represent the younger Kolhan Formation. The oligomictic conglomerate on the western bank of river Baitrani near Inganijoran (85°28′, 22°01′) separates the younger Kolhan Formation from the older Iron Ore Formation. Coarse-grained sandstones are well-exposed on both sides of the river Baitrani and range in thickness from 30 to 60 meters. They are mostly greyish red, cross-stratified, thick bedded and dip 10 to 15 degrees in westerly direction.

Petrography

The sandstones are coarse to medium grained, mature to sub-mature quartz-arenites to quartz-wackes (Pettijohn, 1975). Mmicrometric analysis of fifteen sandstone samples reveals that the mean size (M_z – Folk, 1966) range from 0.80 to 2.05 phi units with maximum concentration (about 65 per cent) in between 0.80 to 1.63 size range. They are mostly moderately (65 per cent) well sorted (.658 phi units) to poorly (35 per cent) sorted (1.21 phi units). The skewness values range from -0.017 to $+0.18$ phi, where 58 per cent fall within nearly symmetrical and about 30 per cent concentrate within fine-skewed range. The range of Kurtosis is from 0.61 to 1.79 phi-units. The platykurtic and very platykurtic constitute about 58 per cent, whereas mesokurtic represents only 42 per cent in samples. The grain-size statistical parameters clearly reveal an overall log-normal distribution, possibly influenced by the provenance rocks as well as fluid mechanisms in the depositional system. The fluctuation of flow velocity is revealed by the elimination of finer suspension load or its addition to saltation or traction populations. The sporadic variations in current velocity are also reflected by sorting of sand-size particles as well as vertical change in the dimension of current structures.

Quartz grains constituting 66 to 88 per cent of sand silt fraction, are mainly monocrystalline undulatory (60 to 65 per cent), non-undulatory (15 to 20 per cent) and 3 to 5 per cent polycrystalline grains. The majority of quartz grains are subangular to subrounded. At times, very well rounded quartz grains occur in textural inversion (Folk, 1966) with the subangular clastics. There is also significant relationship between roundness and mean size of different types of quartz grains. The polycrystalline and non-undulatory quartz grains show sinusoidal relationship with mean-size (M_Z) thus suggesting dual source for sand-grains (Pettijohn, 1975).

Rock fragments varying from 1 to 6 per cent, are usually chert and meta-quartzite sometimes with a few physilites (Weaver, 1980) fragments. The detrital muscovite flakes, constituting less than 1.0 per cent, wrap around detrital quartz grains due to compaction. Feldspars are mostly untwined K-feldspars and represent about 5 per cent of the total arenite framework. Sericitization is usually confined within feldspar grains (Fig. 1). The surrounding detrital silt-size quartz and sericite matrix at places recrystallizes into secondary muscovite due to phyllomorphic changes. Such changes are also accompanied by peripheral dissolution of the quartz detritals, wedging of feldspars along cleavage planes due to invading sericite matrix. Chloritization of feldspars is not widespread.

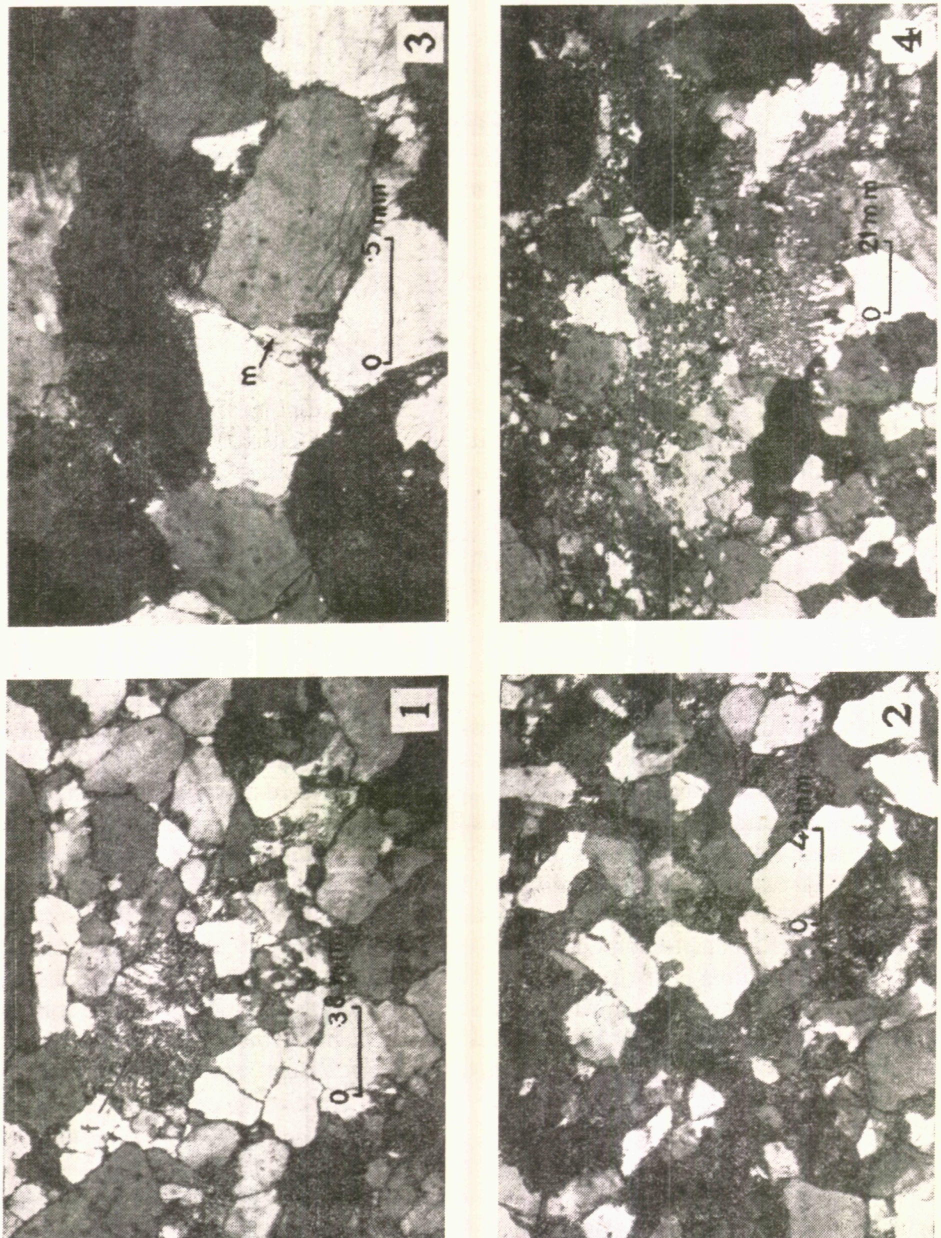
The sand-size detritals are commonly bounded by incompatible matrix and cement. They usually constitute about 10 to 15 per cent of arenite framework. Cementing materials are silica and hematite. The matrix occurs as reconstituted complex aggregates of sericite and crypto-crystalline silica grains. Silica cement essentially forms disseminated clusters within reconstituted matrix or as cement in pore-spaces or as overgrowths around detrital quartz in quartz-arenites. Hematite occurs as incompatible cementing material partially surrounding detrital grains. Heavy minerals are predominantly composed of zircon, tourmaline and sub-rounded rutile grains. The surfaces are often rough in appearance, probably due to the effect of intrastratal dissolution.

Diagenetic features

Common diagenetic features include '*in situ*' alteration of K-feldspar grain and reconstituted detrital sericite-chert matrix. The post-depositional alteration of feldspar is proved by the retention of clastic outline of the original grain (Fig. 1). It is generally controlled by weak cleavage planes in feldspars, as suggested by preferential orientation of sericite flakes in that direction. There are isolated patches of sericite-rich matrix, irregular in outline, apparently squeezed into pore-spaces between resistant quartz grains. In these patches, clastics usually have floating appearance (Fig. 2) so that the finer interstitial constituent does not allow the ferruginous constituent to come in direct contact with each other so as to promote intergranular welding. In quartz-arenite framework coarse grains exhibit long contacts (Fig. 3) between them while smaller grains with equivalent pressure solubility are impinged into larger grains resulting in concavo-convex pressure solution contacts. In sub-mature quartz-arenites chertification due to desilication of argillaceous matrix is common (Fig. 4).

Conclusion

The siliciclastic rocks in the present area vary in composition from pure quartz-arenite to quartz-wackes, the latter being produced by extensive readjustment of sericite-chert matrix during phyllomorphic stage of development. The detritals appear to be derived from weathering and erosion of nearby Singhbum Granite terrain and sedimentary cover belonging to Iron Ore Formation. The nature of cumulative curves and interrelationship of various statistical parameters, roundness, sorting and maturity of detritals, high percentage of undulatory quartz grains, all testify to the deposition of the siliciclastic in a comparatively stable



Figures 1 to 4.

shallow marine (with maximum depth of 10 meters as indicated by C-M diagram, Passega, 1964) to tidal flat environment.

The pore-spaces between detritals are either filled up with silica overgrowth or sericite matrix. The pressure solution and dissolution of quartz tend to be restricted to matrix rich part, whereas authigenic silica has been precipitated mostly in matrix deficient arenites. The entirely reconstituted sericite matrix which corroded and replaced quartz detritals and later post depositional veinlets indicates occasional instability and later tectonic stresses in the depositional sites.

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EXPLANATION OF FIGURES

Figure 1. The post depositional alteration of K-feldspar (f) along the weak planes without obliteration of its original clastic outline. (Cross Nicol)

Figure 2. Quartz-wacke showing peripheral dissolution of detrital quartz grains due to reconstituted sericite-silt size quartz matrix. (Cross Nicols).

Figure 3. Sandstone with secondary mica (m) produced due to recrystallization of sericite matrix. The long intergranular contact is common. (Cross Nicols)

Figure 4. Chertification of argillaceous matrix in submature quartz arenite. (Cross Nicols)