Geol. Bull. Univ. Peshawar, 1984, Vol. 17, pp. 109–112

PRELIMINARY PETROGRAPHY OF THE HANGU SANDSTONE, HANGU, KOHAT

IFTIKHAR ALI ABID AND IFTIKHAR AHMED ABBASI
NCE and Department of Geology, Peshawar University

ABSTRACT

The quartzitic sandstone of the Hangu Formation is mature both texturally and mineralogically. The detritus is diagenetically cemented by secondary silica giving rise to interlocking texture. The petrography and stratigraphic position of the sandstone suggests shallow marine environments of deposition where feldspar, lithic fragments and other softer material were completely destroyed as a result of repeated winnowing by long shore currents, while quartz and a resistant suite of heavy minerals were retained.

INTRODUCTION

The name "Hangu shale and Hangu sandstone" of Davis (1930) was formalized as the Hangu Formation (Lower Paleocene) after Hangu town, south east of Fort Lockhart (Lat. 32°33′ 40″ N, Long. 71° 03′E), Samana Range, Kohat. It unconformably overlies the Kawagarh Formation (Late Cretaceous) and is conformably overlain by the Lockhart Limestone (Paleocene). In the study area, about 2km north of Hangu town, it is 80m thick and is composed mainly of sandstone with a few shale beds in the basal part. The sandstone units are light grey and reddish-brown in colour, fine- to coarse-grained, with thin conglomeratic beds at places. The sandstone units show some graded bedding whereas cross bedding is rare. At other places, e.g., Kohat-Potwar Province, Salt Range, Kala Chitta Range and Surghar Range, the Hangu Formation shows greater lithological variations. In these areas, it includes carbonaceous siltstone, coal, marl, limestone, bauxite and laterite units interbedded with sandstone, shale, ferrogeneous oolitic and pisolitic sandstone units (Shah, 1980).

The present study of the Hangu Formation is based on petrographic data of 12 thin sections from the type area. Two samples were stained with sodium cobaltinitrate for K-feldspar identification. Chemical analyses of two samples were carried out to evaluate the economic potential of the sandstone in glass industry. Samples were collected in a stream from bottom to top of the Hangu Formation.

PETROGRAPHY

The sandstone is principally composed of quartz (>95%), the remainder being tourmaline, opaques, clay minerals and traces of sphene, zircon, muscovite, biotite, and chert (Table 1). This classifies the Hangu Sandstone as quartzarenite (Williams *et al.*, 1954; Krynine, 1940). Quartz grains are well rounded to rounded, mostly monocrystalline and have straight extinction. However, some are polycrystalline, showing undulose extinction. Inclusions of Zircon, muscovite, biotite, tourmaline and apatite are observed in quartz grains which show advanced stage overgrowth of silica in all thin sections. This overgrowth may be the result of dissolution of silica at grains' contacts and then precipitation in the pore spaces (Weyl, 1959; Skolnick, 1965; Durney, 1976; De Boer, 1977). Effects of pressure are suggested by the tabular flakes of muscovite which are bent around quartz grains.

Detrital tourmaline is the most abundant heavy mineral in the Hangu Sandstone. It is mostly schorlite and is strongly pleochroic from light brownish-green to brown. Its grains are generally well-rounded to rounded, indicating strong effects of abrasion by long transportation. However, a few grains are subhedral with sharp crystallographic edges. Rounded zircon and euhedral sphene grains, interstitial clay minerals, and irregular patches of ore minerals are also present.

TABLE 1. MODES OF THE QUARTZITIC SANDSTONE (VISUAL ESTIMATES)

	H—2	H—4	H—6	H—8	H—10	H—12	H—14
Quartz	96.0	97.3	95.9	96.5	96.9	97.0	98.8
Tourmaline	1.5	1.0	0.5	1.5	0.4	0.5	1.2
Opaque	1.3	0.1	2.0	0.6	1.0	0.5	Tr
Clay Minerals	1.0	1.5	1.5	1.3	1.4	1.9	Tr
Zircon	Tr	Tr	—	Tr	—	—	Tr
Sphene	—	—	—	Tr	Tr	—	—
Biotite	—	—	—	—	Tr	Tr	—
Muscovite	Tr	Tr	—	—	—	—	—
Chert	Tr	Tr	Tr	—	—	—	—

H—2 to H—14. Quartzitic Sandstone, Hangu Formation (Paleocene), 2 km north of Hangu Town.

Texture and Cement

The Hangu Sandstone is mature to supermature, both mineralogically and texturally. This is suggested by the mineral composition (Table 1), rounded grains, and good sorting with clay contents of less than 5%. Such texture is more frequently produced in high energy setting, especially near beaches (Scholle, 1979). Textural inversion (well-rounded but poorly-sorted) is noted in three thin sections. Grain to grain relationship is mostly in the form of sutured and concavo-convex contacts, however, straight contacts are also present. Patches of bilateral boundaries and triple grain junctions are observed in thin sections, indicating advanced stage of diagenesis and more stable configuration (Sippel, 1968; Spry. 1969). Secondary silica is the only cementing material in all thin sections. Quartz grains are closely packed and show interlocking texture caused by the advanced stage of quartz overgrowth. Almost all pore spaces have been filled with quartz cement. Contacts between adjacent overgrowths are irregular and suggest mutual interference during crystal growth.

CHEMISTRY

SiO_2 and Al_2O_3 of the samples were determined gravimetrically while the rest of the oxides by spectrochemical methods (Table 2). The data show that the samples are enriched in SiO_2 and contain less than 0.34% of Na_2O + K_2O. As there is a total lack of feldspar in the rocks, the alkali (K_2O + Na_2O) content might be due to the presence of clay minerals and tourmaline. The total iron content (Fe_2O_3) is low (<0.1%), and this make it feasible for glass industry.

TABLE 2. CHEMICAL ANALYSES OF THE QUARTZITIC SANDSTONE

No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	Mgo	CaO	Na_2O	K_2O	P_2O_5	Ig. Loss	Total
H—4	98.43	0.00	0.90	0.10*	0 00	0.00	0.01	0.23	0.10	0.00	0.01	99.78
H—14	98.40	0.00	1.08	0.08*	0.00	0.00	0.04	0.18	0.13	0.00	0.02	99.93

* Fe_2O_3 expressed as total iron. Analyst M. Tahir Shah.

DISCUSSION

The quartz arenite of the Hangu Formation in the type locality is multicyclic, well-sorted, and exhibits a high degree of mineralogical and textural maturity. Its occurrence between two limestone units (the Kawagarh Formation at base and the Lockhart Limestone at top) and traces of chert in it are suggestive of shallow marine origin and deposition on a stable cratonic portion of the continent (Pettijohn, 1975; Dickinson and Suczek, 1979). The deposition occurred in an oscillating shallow sea characterized by transgression and regression. The good sorting of the sandstone may be partly attributed to the wind action during the interval of regression as observed in the St. Peter Sandstone (Thiel, 1935). Sand brought to the coastal areas can become highly quartzose (Qtz. 90–95%) by enrichment from local coastal plain sediments (Cleary and Conolly, 1971). The contribution of material from two different sources in the sandstone of the Hangu Formation is evident by the presence of well-rounded and subhedral tourmaline grains with euhedral sphene and rounded zircon grains. The textural inversion in the sandstone also reflects the deposition in high energy environments. The abundance of quartz with minor amount of heavy minerals and absence of feldspar and lithic fragments is due to mechanical destruction of softer material.

Chemical analyses and preliminary petrography of the samples grade them as silica sand/glass sand, however, a detail study based on the geological mapping, geochemical analyses of the channel samples, size analyses and petrographic study will help to evaluate the deposit.

REFERENCES

Cleary, W.J. & Conolly, J.R., 1971. Distribution and genesis of quartz in a piedmont-coastal plain environments. Geol. Soc. Am. Bull. 81, 2755—2763.

Davies, L.M., 1930. The fossil fauna of the Samana Range and some neighbouring area. Geol. Surv. India, Mem. 15, 15—24.

De Boer, R.B., 1977. On the thermodynamics of pressure solution interaction between chemical and mechanical forces. Geochem. Cosmochim. Acta 41, 249—256.

Dickinson. W.R. & Suczek, C.A., 1979. Plate tectonics and sandstone compositions. A.A.P.G. Bull. 63, 2164—2182.

Durney. D.W., 1976. Pressure solution and crystalline deformaton. Phil. Trans. R. Soc. London 283A, 229—240.

Krynine, P.D., 1940. Petrology and genesis of the Third Bradford Sand. Pennsylvania State College Bull. 29, 1—134.

Pettijohn, F.J., 1975. Sedimentary Rocks. Harper and Row, New York.

Scholle, P.A., 1979. A color illustrated guide to constituents. texture, cement, and porosities of sandstones and associated rocks. A.A.P.G. Mem, 28.

Sippel, R.F., 1968. Sandstone petrography, evidences from luminescence petrography. Jour. Sed. Petrol. 38, 530—554.

Shah, S.M.I., 1980. Stratigraphy and economic geology of the Central Salt Range. Geol. Surv. Pakistan. Rec., 52, 18—20.

Skolnick, H., 1965. The quartzite problem. Jour. Sed. Petrol. 35, 12—21.

Spry, A., 1969. Metamorphic textures. Pergamon, Oxford.

Thiel, G.A., 1935. Sedimentary and petrographic analyses of the St. Peter sandstone. Geol. Soc. Am. Bull. 46, 559—614.

Weyl, P.K., 1959. Pressure solution and the forces of crystallization. Jour. Geophy. Res. 64, 2001—2025.

Williams, H., Turner, F.J. & Gilbert, C.M., 1954. Petrography. San Francisco, Freeman.