

Mössbauer Spectroscopic Study of the Sedimentary Samples Collected from Fatehgarh Formation of Northern Barmer Basin, Western Rajasthan (India)

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ABSTRACT: Fatehgarh Formation is limited to the northwestern of Barmer Basin. The Fatehgarh Formation overlies the Jurassic with an unconformable contact and is overlain by white Siliceous. The formation is a thick sequence of coarsening upward. It commences with a 3 to 4 m thick basal conglomerate bed. The Mössbauer spectroscopic study of the sedimentary samples collected from Fatehgarh formation was carried out. The complex pattern of Mössbauer parameters attributed to goethite, pyrite and other minerals were recorded.

KEYWORDS: Mössbauer, Sediment, Formation & minerals etc

I. INTRODUCTION

Barmer basin was formed when the Indian creation broke up toward the one Cretaceous and led to the formation of the Cambay rift and constituent basin in the northwestern part of India. Barmer basin is one of the constituent basins. It is a narrow north-south trending graben that comprises sediments of middle Jurassic to lower Eocene age (Mathur et al., 2006; Compton (2009). The basin's presence was suspected from gravity in the late 1980s but not confirmed until 1999 from seismic, magnetic, and drilling data that the basin is a lacustrine failed rift. The Cretaceous to Paleocene sediments of the northern part of the Barmer basin are named as Fatehgarh Formation. The details study about the geology, origin of major oil reservoir in the Fatehgarh Formation is discussed in detail by Compton (2009) and Dolson (2015). It is well known that iron-bearing minerals are significant and important component of sedimentary samples and carry a lot of information about their depositional history.

⁵⁷Fe Mössbauer spectroscopy is particularly useful for the characterization of iron-bearing minerals because it gives first-hand information about the atomic environment of iron nuclei and, hence, leads to direct identification of the compounds and their chemical states.

II. EXPERIMENTAL

For present study few sedimentary samples were collected from Fatehgarh Formation. Fraction of these powdered samples was used for Mössbauer study. The Mössbauer absorbers were prepared by using fraction of these finely ground powder sediment in a sample holder (25 mm in diameter). The thickness of the absorbers was always kept constant. Mössbauer spectra were recorded at room temperature (300K) with a conventional constant acceleration spectrometer using a 10 mCi source ⁵⁷Co in a Rh matrix. The isomer shift (IS) has been reported with respect to the centroid of a 25- μ m thick α -iron foil spectrum. Each spectrum was fitted using a computer program. This program

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assumes the spectrum to be the sum of Lorentzians. In most of the cases, width and intensity of the two halves of a quadrupole doublet or six halves in case of sextet were constrained to be equal. While in the case of sextet intensity of line 1 and 6, 2 and 5 and 3 and 4 were constrained to be equal. The relative intensities of various mineral components or sites were calculated by adding the areas of the two halves of the corresponding doublet or six halves of the corresponding sextet and are expressed as a fraction of the total area of resonant absorption. Solid lines in the spectra reported here represent computer-fitted curves and dots represent the experimental points. The χ^2 values are generally obtained in this range. However, a little deviation in the χ^2 has been accepted on few occasions when the iterations do not yield to further improvements in χ^2

Typical Mössbauer spectra at room

Temperature:

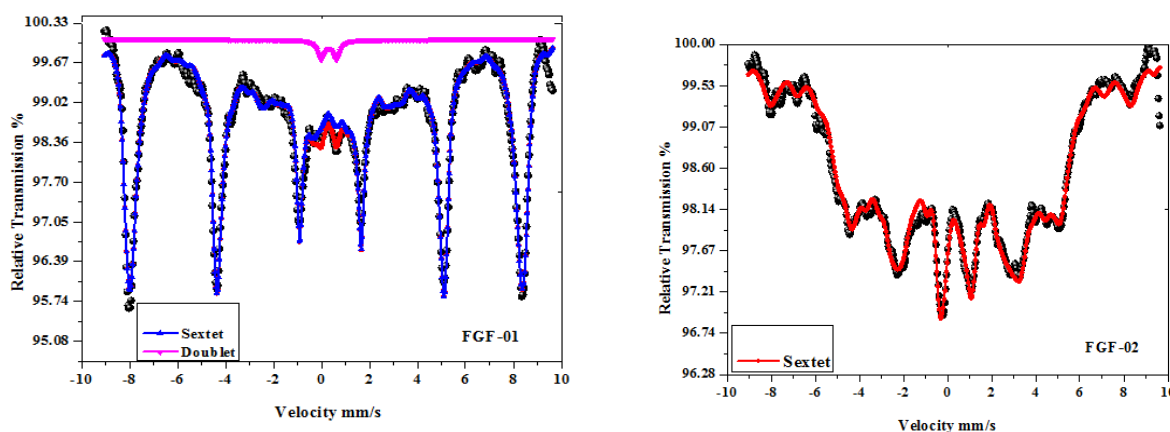


Figure-1: Mössbauer spectrum of samples FGF-01 and FGF-02 collected from Fatehgarh Formation.

Table-01: Mössbauer parameters of the Fatehgarh Formation Samples

Sample Code	Spectrum	IS (mm/s)	QS (mm/s)	LW (mm/s)	Magnetic Field	Relative Area %	χ^2	Assignment of Peaks
FGF-01	Sextet	0.2843	-0.1838	0.2591	38.1303	98.57	1.665	Goethite or Hematite
	Doublet	0.3078	0.6352	0.3661	-	1.43		Pyrite
FGF-02	Sextet	0.2630	-0.2220	0.3112	26.4231	100	1.205	Goethite

III. DISCUSSION AND RESULT

Mössbauer spectra of the sample FGF-01 exhibit presence of one sextet and one doublet and sample FGF-02 exhibit presence of one sextet. Table-01 exhibit Mössbauer parameters like Isomer shift (IS), quadrupole shift (QS), line

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width(Lw), Relative area and χ^2 . These Mössbauer spectra and parameters show the presence of the goethite and hematite with low hyperfine magnetic field. To link the observation conclusively with volcanic activity more Mössbauer study is needed in future on sedimentary sample from other volcanic provenance.

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