

Geochemistry and Origin of Banded Iron-Formation from the Granulitic Terrain of North Arcot District, Tamil Nadu, South India

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Abstract: Banded iron formations (BIF) form an important part of the Archean supracrustal belts of South India. Major, trace and rare earth elements (REE) chemistry of the banded iron formation of Kavuthimalai-Vediyappanmalai area, North Arcot district, Tamil Nadu region are utilized to compare with other world BIF and explore that this a separate type of Tamil Nadu type. The petrographic observation and the study of REE indicates that this BIF are derived from mantle through hydrothermal solutions and fumarolic activity in submarine conditions with an age of approximately 3800 m.y. old.

Keywords: Banded iron formation (BIF), Rare earth elements (REE), Hydrothermal solutions, Granulite facies

Introduction

The strikingly banded rocks scattered across the upper Midwest and elsewhere throughout the world are actually ambassadors from the past, offering clues to the environment of the early earth more than 2 billion years ago. Called banded iron formations or BIFs, these ancient rocks formed between 3.8 and 1.7 billion years ago. The stripes represent alternating layers of silica-rich quartz and iron-rich minerals like hematite and magnetite. In India, iron-formations were designated as “Banded Hematite Quartzite” and “Banded Magnetite Quartzite”. Stratigraphic connotations like Iron Ore Series are given to these rocks in Bihar, Orissa, Andhra Pradesh and Tamil Nadu¹⁻⁴. In other countries names like Taconite (Lake Superior), Itabirite (Brazil), Jaspilite (Australia) and Calico rock (South Africa) have been in use. Former subdivided the charnockite region of South India into Iron-Ore province and Magnese-Ore province- the Salem, Arcot and Madras provinces of Tamil Nadu and Prakasam province of Andhra Pradesh were included in the Iron-Ore province and the rest comes under Manganese-Ore province.

The Banded Iron Formations occur in high grade granulite terrain and greenstone terrain of South India in the states of Karnataka, Kerala, Tamil Nadu and Andhra Pradesh. The BIF of Arcot district of Tamil Nadu are associated with Pyroxene granulites, charnockites and granite gneisses. The area under study, being a part of North Arcot district comes under Iron-Ore province, since it includes iron ore as one of the rock types.

Geological background of the area

The area under study forms the part of granulitic terrain of South India. It lies between $12^{\circ} 15' - 12^{\circ} 19'$ North latitudes and $78^{\circ} 58' - 79^{\circ} 05'$ East longitudes around Kavuthimalai-Vediappanmalai area, North Arcot district, Tamil Nadu. In this area pyroxene granulites, charnockites, granite gneisses and Banded Iron Formations (BIFs) are present according to their order of superposition. The pyroxene granulites, charnockites and granite gneisses show sharp contacts with one another. The charnockites have xenoliths of pyroxene granulites, which indicates the former as younger. Finally the BIFs deposited after the fault zone was taken place in NE-SW direction and later metamorphosed (Figure 1).

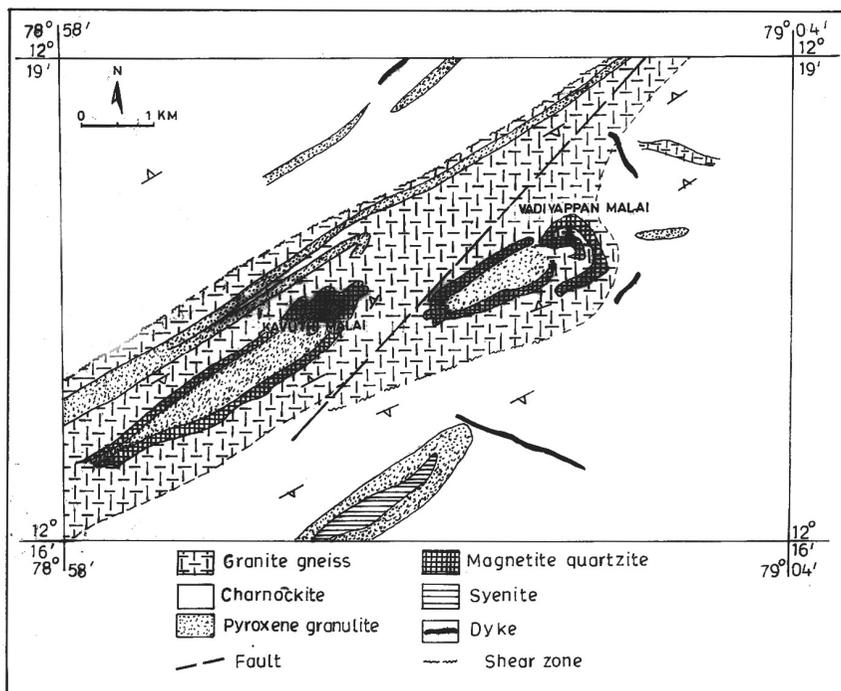


Figure 1. Geological map of the study area

The BIFs in the western portion of the fault occur as steeply dipping on the top as basin-like structure. On the Eastern end of this hill the BIFs on the Northern flank is repeatedly folded and is connected with the Southern flank at a point near the peak of the hill. The rocks show distinct banding, due to the occurrence of thin discontinuous ribbons and laminae of quartz alternating with those rich in dark iron minerals. The BIFs are well-banded rocks consisting of millimeter to centimeter thick alternating iron-rich and silica-rich layers. The ore in the northern limb is medium to coarse grained, while in the southern limb it is usually medium grained. In places, especially in the eastern region of the hill magnetite patches are very coarse grained, with well developed crystals.

Petrography

The petrographically the BIFs composed of Magnetite and quartz with minor proportions of hypersthene, hedenbergite, commingtonite/grunerite, garnet and apatite are noticed in these rock formations. Magnetite occurs as irregular grains or bands. The association of magnetite

with quartz ranges from granular to well banded nature with alternate layers of quartz and magnetite. Numerous cracks in quartz filled with iron oxide are present. In some cases the veins appear to be feeding the iron oxide bands. In some sections fine hair like cracks from the iron oxide grains extends in to quartz grains, which form a mesh like network.

Under reflected light magnetite is grey in colour with brownish tinge. The octahedral and cubic parting planes are noticed. The cubic nature of parting planes indicated by triangular pits. In some samples magnetite shows faint anisotropism due to the presence of martite formed by martitization, along the octahedral parting planes and thus giving rise to a network of triangular lattice pattern. Martite is identified by its high reflectance than magnetite and by its light grey in color with bluish tinge.

Quartz is the dominant mineral in many assemblages. It occurs as elongated grains and alternate bands with magnetite. This mineral is also occurs as inclusions in magnetite. The grain size is observed to be finer at the contact with magnetite than far off. The deformation effects in quartz are marked by marginal granulation and development of numerous cracks filled with iron oxide. The individual grains of quartz contain dust like numerous inclusions of magnetite.

Sampling and analytical techniques

Proper care was taken to collect the best possible fresh sample. Samples with mesoband thicknesses below 3 mm were selected for major and trace elemental analysis. The major elements and trace elements were determined by x-ray fluorescence method in the laboratory of the Atomic Mineral Division, Hyderabad. Rare Earth Elements (REE) were determined by Instrumental Neutron Activation Analysis (INAA) at the Department of Earth

Sciences, University of Lowell, Massachusetts, USA. The standards were checked against the standards of BRC-1 and AUG-1. Reproducibility and estimated analytical errors were less than 5% for major and trace elements.

Results and Discussion

Geochemistry of banded iron formations

Major element chemistry of the ten representative BIF samples is shown in Table 1. SiO₂ and Fe₂O₃ constitute nearly 96% to 99% of the bulk of the banded iron –formations. SiO₂ and Fe₂O₃ content of the studied banded iron-formations have an inverse relationship to each other. Al₂O₃ content varies between 0.10 and 0.63%. Na₂O and K₂O content are very low in the studied samples. P₂O₅ content in the banded iron-formations ranges between 0.15 and 0.43%. MnO content ranges between 0.1 and 0.3%. MgO (0.52 – 2.00%) and CaO (0.23 – 1.25%) contents are significantly very low.

The average composition of BIF of the study area is compared with average chemical compositions of BIF of different areas of the world are shown in Table 2. When the average values of the Archaean, Proterozoic, Superior, Algoma, Orissa and study area are plotted against the respective oxide percentages (Figure 2), it is observed that there is a significant variation in Fe₂O₃ and P₂O₅ proportions which are high in the study area BIFs, whereas Al₂O₃ and CaO are in much lower proportion. The average proportions of MgO and K₂O of study area show similarity with MgO and K₂O of Superior oxide facies, but it differs from Algoma oxide facies. MnO (0.23) of the study area is similar to the Algoma oxide facies (0.22). Na₂O (0.23) is similar to the Archaean and Proterozoic BIF proportions of 0.22 and 0.29 respectively, but it is lower to the Algoma type BIF(0.31) and higher to that of Superior type (0.12).

Table 1. Chemical composition of BIF of the study area

	1/K85	2/V74	3/K89	4/V72	5/K16	6/V65	7/K79	8/V59	9/V87	10/K90	Average
Major Elements (wt%)											
SiO ₂	47.55	43.65	48.10	39.20	47.20	41.10	46.00	42.51	46.10	44.89	44.62
TiO ₂	0.32	0.23	0.25	0.35	0.48	0.10	0.20	0.33	0.20	0.40	0.22
Al ₂ O ₃	0.10	0.35	0.63	0.56	0.30	0.32	0.33	0.35	0.15	0.36	0.35
Fe ₂ O ₃	49.07	54.07	49.72	56.90	50.48	57.28	50.75	56.44	51.45	53.14	53.00
MgO	1.00	1.45	1.15	2.00	1.05	0.52	1.50	0.75	1.45	0.25	1.21
CaO	0.85	1.25	0.30	0.23	0.50	0.35	1.22	0.43	1.24	0.63	0.70
Na ₂ O	0.15	0.18	0.22	0.65	0.19	0.15	0.17	0.22	0.10	0.30	0.23
K ₂ O	0.10	0.17	0.20	0.15	0.15	0.40	0.10	0.13	0.10	---	0.17
MnO	0.20	0.24	0.23	0.22	0.30	0.22	0.21	0.10	0.28	0.25	0.23
P ₂ O ₅	0.28	0.15	0.39	0.43	0.27	0.15	0.35	0.28	0.29	0.20	0.28
CaO/MgO	0.85	0.86	0.26	0.12	0.47	0.67	0.78	0.58	0.84	0.51	0.60
Mn/Fe	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.07	0.03	0.02	0.03
Trace Elements (ppm)											
Co	6.00	---	8.00	---	10.00	---	---	---	5.00	---	7.00
Cr	85.00	156.00	81.00	120.00	102.00	143.00	75.00	94.00	98.00	135.00	109.00
Ni	15.00	22.00	19.00	26.00	17.00	28.00	16.00	23.00	12.00	25.00	21.00
V	38.00	42.00	23.00	56.00	26.00	43.00	20.00	32.00	39.00	31.00	35.00
Cu	16.00	28.00	14.00	19.00	32.00	19.00	25.00	30.00	26.00	23.00	23.00
Ba	28.00	22.00	16.00	13.00	18.00	30.00	21.00	19.00	40.00	26.00	23.00
Sr	16.00	24.00	13.00	10.00	6.00	19.00	8.00	26.00	12.00	18.00	15.00
Co/Ni	0.40	---	0.42	---	0.59	---	---	---	0.41	---	0.46

Table 2. Comparison of the study area major element (wt%) with other BIF types areas of the world

Constituents	1	2	3	4	5	6
SiO ₂	50.50	47.20	47.30	46.90	47.02	44.62
Al ₂ O ₃	3.00	1.39	1.25	1.15	0.70	0.35
Fe ₂ O ₃	41.33	44.51	45.79	43.76	53.33	53.21
MgO	1.53	1.24	3.66	4.41	0.13	1.21
CaO	1.51	1.58	2.84	4.43	0.17	0.70
MnO	0.22	0.73	0.59	0.59	0.06	0.23
Na ₂ O	0.31	0.12	0.22	0.29	0.10	0.23
K ₂ O	0.58	0.14	0.09	0.48	0.13	0.17
P ₂ O ₅	0.21	0.06	0.22	0.14	0.07	0.28

1-Average Algoma-type oxide facies⁵, 2-Average Lake Superior-type⁵, 3- Average Archean BIF⁶,
4-Average Proterozoic BIF⁷, 5-Average of Orissa BIF⁸, 6-Average of the study area BIF

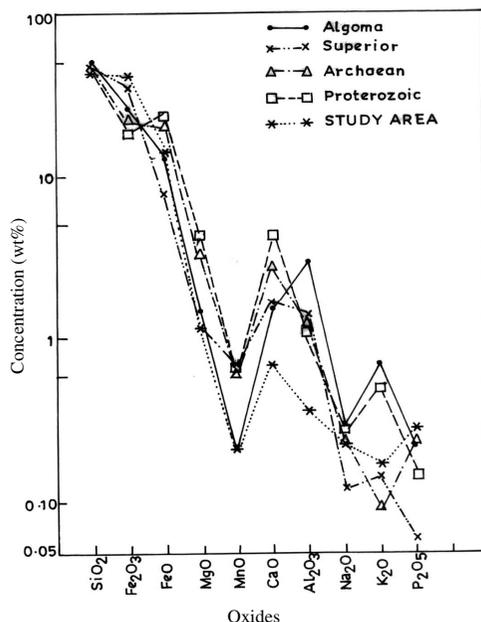


Figure 2. Variation in chemical composition of the study area and other world BIF

The REE content of the selected samples of BIF are estimated and presented in Table 3, and chondrite normalized REE patterns are shown in Figure 3. The average REE content compared with other BIF of world is given in Table 4 and in Figure 4. The low REE concentrations of BIF of the study area are consistent with the REE data of Archaean iron-formations elsewhere⁸. The chondrite normalized REE patterns of the study area are similar to those reported from BIF of Isua of Green land^{8,9}, sargur supracrustals of South India.

Table 3. The REE concentration (in ppm) of BIF

REE	1/V72	2/V74	3/V59	4/K79	5/K16	6/K90	Average
La	2.41	2.60	3.80	3.40	4.93	2.40	3.36
Ce	3.39	8.70	7.00	6.40	9.61	5.90	6.83
Nd	1.81	5.00	3.80	2.90	5.43	4.30	3.87
Sm	0.59	0.53	1.40	0.62	1.26	0.74	0.86
Eu	0.35	0.35	0.72	0.42	0.89	0.50	0.54
Tb	0.16	0.10	0.27	0.18	0.21	0.37	0.22
Ho	0.15	---	---	0.24	0.25	0.51	0.19
Yb	0.45	0.35	0.96	0.57	0.68	1.10	0.69
Lu	0.09	0.06	0.19	0.13	0.14	0.21	0.14
LREE	8.55	17.18	16.72	13.74	22.12	13.84	15.36
HREE	0.85	0.51	1.42	1.12	1.28	2.19	1.24
∑REE	9.40	17069	18.14	14.86	23.40	16.03	16.60
La/Lu	26.78	43.33	20.00	26.15	35.21	11.42	23.29
Nd/Yb	4.02	14.20	3.96	5.09	7.99	3.91	5.60
Eu/Sm	0.59	0.66	0.51	0.68	0.71	0.68	0.63
LaN/YbN	3.61	5.02	2.67	4.04	4.91	1.47	3.62
LREE/HREE	10.06	33.69	11.71	12.27	17.28	6.32	12.39

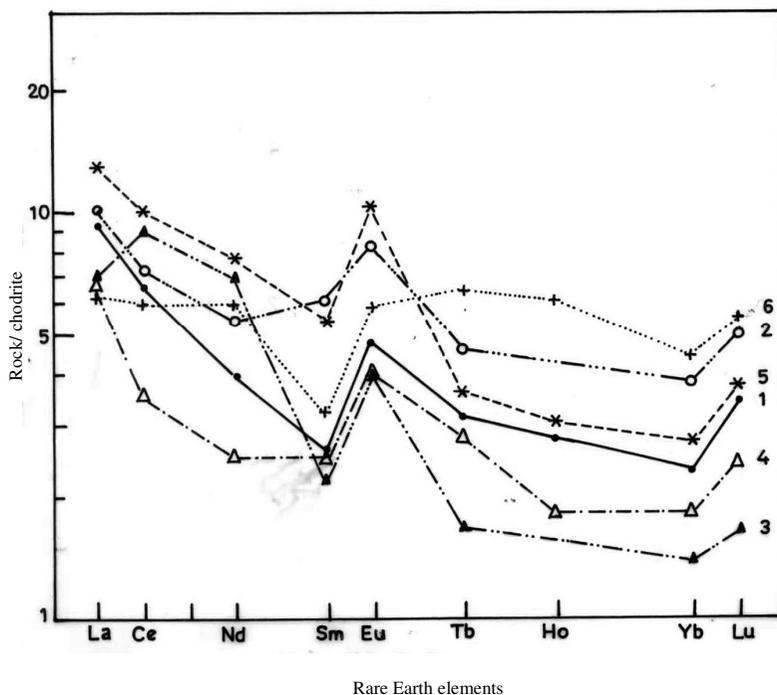


Figure 3. Chondrite normalized REE abundance of the study area

Table 4. Comparison of the study area REE content (in ppm) with other BIF types

REE content	1	2	3	4	5	6
La	3.930	2.260	2.720	2.310	1.850	30260
Ce	6.170	3.700	4.520	6.300	6.700	6.830
Nd	3.660	1.990	2.370	4.700	---	3.870
Sm	0.599	0.359	0.434	0.570	0.437	0.860
Eu	0.389	0.202	1.151	0.580	0.187	0.540
Tb	---	---	---	---	0.132	0.220
Ho	0.191	0.116	---	0.460	---	0.190
Yb	0.622	0.380	0.242	1.570	0.850	0.690
Lu	0.106	0.067	0.032	0.200	0.138	0.140
\sum REE	15.620	9.074	10.460	16.620	10.290	16.600
Eu/Sm	0.640	0.560	0.340	1.010	0.427	0.630
La/Yb	6.320	5.940	11.230	1.350	2.176	4.720

1-Massive magnetite, Buffin Island; 2- Average Archean oxide facies Iron-Formation, 3-Average Sokoman oxide facies, Labrador; 4- Sedimentary magnetites from the Orissa; 5-Average of Sargur BIF; 6- Average of the present area BIF

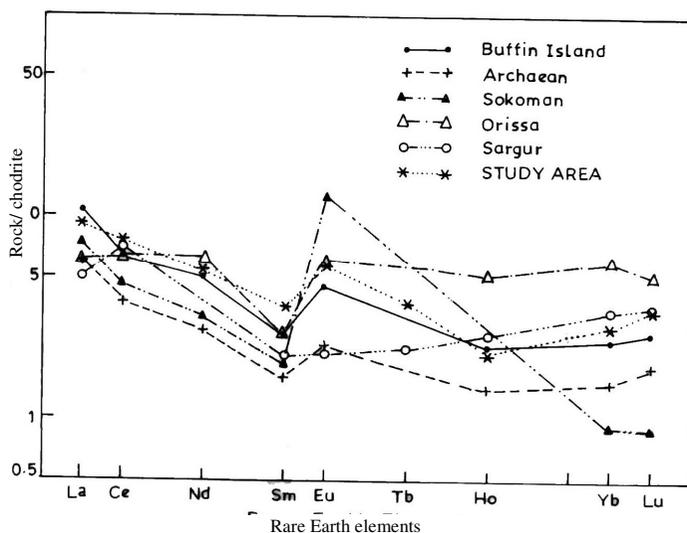


Figure 4. Chondrite normalized REE abundance of the study area and other world BIF

BIF has been reported from different parts of the world and the source of Fe and Si within BIF is an intriguing problem^{10,11}. Mid-oceanic ridge or hot spot style tectonic setting are likely settings from where iron could have released during these tectonic activities^{12,13}. The several giant and world class ore systems were formed during intra-plate tectano-thermal and rifting events¹⁴. Iron was scavenged from the early Achaean oceanic crust and re-deposited on the ocean floor by hydrothermal fluids aiding the deposition of BIFs¹⁵. It is difficult to attribute a single depositional model for the formation of BIFs and the reason for lack of uniform genetic model may be attributed to their formation at long span of depositional episodes during Precambrian time.

The banded iron formations and associated rocks of the study area had undergone granulite facies of metamorphism¹⁶. To decipher the nature of original material is not so easy; more so when materials of similar composition may be formed by diverse processes and also any attempt to understand the origin must be based on features on them due to metamorphism, as the granulite facies conditions obliterates the original structures.

In the petrographical study it was found that magnetite occurs in the form of veins filling up the cracks, which seem as feeders to the concentrated bands. The veins are more or less perpendicular to the bands and the presence of closely spaced fractures cutting across the quartz grains indicates that the rocks were subjected to deformational forces. It is possible that the iron oxide which was mobilized during metamorphism moved into these cracks, fractures and granulated regions, thus occupying the areas of low pressure.

Normalized REE patterns show general paucity of REE, relative enrichment of LREE over HREE, positive Eu anomalies, low proportions of Ce, Sm, Lu and La/Lu ratio suggests that the study area BIFs are Archaean sedimentary in nature¹⁶⁻¹⁹. Manikyamba *et al.*,²⁰ suggested that La enrichment, positive Eu and low proportions of Ce and Sm in BIF of Sandur Schist Belt indicates that the iron formations received their constituents from hydrothermal solutions derived from mantle along with the associated basic volcanism. Khan *et al.*,²¹ suggested that the REE, iron and silica of BIF are derived from mantle through hydrothermal solutions.

The low proportions of Ce and Sm in BIF of the study area may be due to differentiation during diagenetic changes and metamorphism^{24,25}. Most of the Archaean iron-formations are characterized by relative enrichment of Eu compared to the other REE, whereas Eu abundance is in Proterozoic iron-formations. Relative enrichment of Eu in Sargur BIF substantiates the above view of enrichment of Eu in Archaean BIF. Eu anomalies in iron-formations have been used as indicators of oxidizing and reducing conditions in the Precambrian atmosphere^{6,26}. Presence of Eu anomaly in the study area BIF indicates prevalence of oxidising environment at the time of deposition during Archaean times⁸. Hydrothermal solutions extremely depleted with REE, but show positive Eu anomaly and La enrichment²⁷. The relationship between $\sum (\text{Co} + \text{Cu} + \text{Ni})$ and $\sum \text{REE}$ of hydrothermal and hydrogenous deposits are used by Dymek and Klein²⁸ Klein and Beukes²⁹ to reconstruct the fields of hydrothermal and hydrogenous deposits (Figure 5). All the samples of the study area BIFs fall within the field of hydrothermal deposits, which also suggest that the major part of the iron in the studied banded iron formations were added to the bottom sea water by hydrothermal solutions derived from hydrothermally active marine environments. However it is confirmed that the La enrichment, depletion of total REE, positive Eu anomaly, Nd/Yb, La/Lu and LREE/HREE ratios of BIFs of the study area indicate that iron silica and REE were supplied by hydrothermal and fumarolic activity accompanying submarine environment.

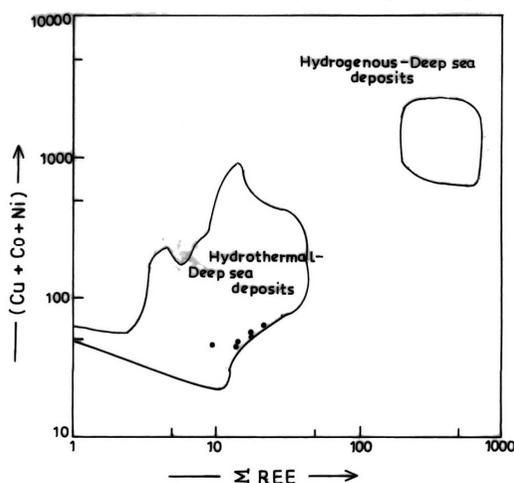


Figure 5. $(\text{Cu} + \text{Co} + \text{Ni})$ vs. REE plot showing the hydrothermal source of REE and other constituents for BIF of the study area.

In view of the above observations of ferried elemental, major elemental distribution, presence of vein connections in the magnetite grains and bands, the association of meta-volcanics, presence of good banding, granulite texture, their association with commingtonite/grunerite it is concluded that magnetite-quartzites are meta-sediments, which may be formed originally through hydrothermal and later metamorphosed.

The average analysis of the BIF of the study area compared with those of Algoma, Superior and Sargur BIF (T.N. Type), is given the Table 5. The major elemental concentrations of the study area differ markedly from those of the Algoma and Superior types *viz.*, SiO_2 , Al_2O_3 , CaO, MgO and MnO values are relatively low and FeO content is high. It is observed that the absence of CO_2 and S, the study area is akin to Tamil Nadu type of Sargur area.

Table 5. Comparison of the study area BIF major elements (Wt%) with other world BIF types

Constituents	Algoma 1	Superior 2	T.N type 3	Study area 4
SiO ₂	50.50	47.20	49.16	44.62
Al ₂ O ₃	0.300	1.39	0.97	0.35
FeO ^t	37.21	40.06	42.60	47.87
MgO	1.53	1.23	1.59	1.21
CaO	1.51	1.58	1.59	1.79
Na ₂ O	0.31	0.12	0.10	0.23
K ₂ O	0.58	0.14	0.71	0.17
MnO	0.22	0.73	0.19	0.21
P ₂ O ₅	0.21	0.06	0.05	0.20
CO ₂	0.29	0.02	---	---

Origin

Meta-sedimentary origin was advocated, by many workers²⁶ for the magnetite-quartzite of Tamil Nadu and Iron ores of South India. The magnetite-quartzite which are of sedimentary origin may be originally formed in the form of a residual deposit, chemical precipitate, biogenic formation, volcano sedimentary or hydrothermal in nature.

In the petrographical study it was found that magnetite occurs in the form of veins filling up the cracks, which seem as feeders to the concentrated bands. The veins are more or less perpendicular to the bands and the presence of closely spaced fractures cutting across the quartz grains indicates that the rocks were subjected to deformational forces. It is possible that the iron oxide which was mobilized during metamorphism moved into these cracks, fractures and granulated regions, thus occupying the areas of low pressure.

Ramberg²⁷, Turner and Verhoogen²⁸ believed that the process operating within a rock leading to the formation of layers of contrasting mineralogy constitute the metamorphic differentiation. If the original material that produced the magnetite-quartzite consists of both silica and iron oxide, it is probable that the iron oxide is segregated into bands moving along the cracks and fractures during deformation. In this process the iron oxide which was originally present, possibly in a dispersed form has to be concentrated into bands by drawing the material from external source of fractures even in the granulite facies metamorphism and the structures of veins connecting the bands in the magnetite-quartzite show that the iron oxide has migrated into the rock from somewhere any they do not show any evidence of obtaining the material within the rock.

The magnetite quartzite of the study area show low concentration of Al₂O₃, CaO and MnO, which infers the non-volcanogenic origin. Very low concentrations of Na₂O and K₂O values also substantiate the above observation²⁹. Paucity of REE, relative enrichment of LREE over HREE, La enrichment, positive Eu and low proportions of Ce and Sm of this study area indicates that the iron silica and REE of BIF are derived from mantle through hydrothermal solutions and fumarolic activity in submarine conditions. The same opinion was expressed by Manikyamba *et al*²⁰.

In view of the above observations of ferried elemental, major elemental distribution, presence of vein connections in the magnetite grains and bands, the association of meta-

volcanics, presence of good banding, granulite texture, their association with commingtonite/grunerite it is concluded that magnetite-quartzites are meta-sediments, which may be formed originally through hydrothermal and later metamorphosed.

Holland¹⁰ has postulated upwelling of deep ocean water as an alternative source of iron in iron formations, Windley *et al.*,³⁰ and Grass³¹ consider these alternative mode of transport of iron from a submarine hydrothermal source to a zone of precipitation as the dominant process in the deposition of iron formations.

Age

Several workers have given the ages of different horizons based on mineralogy, geochronology and chemical analysis. Jayaram *et al.*³² inferred that the iron formations of Southern Karnataka belongs to Precambrian age and they may be as old as 3,600 m.y, on the basis of geological association and geochronological data of the associated rocks such as cordiorite and charnockites. The ages of the oldest gneisses of granulite facies from south India³³ and for the charnockites of Tamil Nadu³⁴ are 3065± and 2900 to 3200 respectively. Lepp and Goldich³⁵ have compared the age of various iron formations on the basis of major elements as given in the Table 6.

Table 6. Comparison of chemical analysis of study area BIF with precambrian and post-precambrian BIF formation

Constituent	Precambrian	Post-precambrian	Present study area
SiO ₂	42.90	12.90	44.62
Al ₂ O ₃	1.60	6.10	0.35
CaO	1.50	14.30	1.70
MgO	2.80	2.90	1.20
MnO	1.00	0.34	0.23
P ₂ O ₅	0.26	0.86	0.28
TiO ₂	0.15	0.45	0.22
Mn/Fe	0.028	0.009	0.028
CaO/MgO	0.590	8.800	0.595

From the major elemental concentration it is noticed that: Precambrian iron formations are characterized by their high content of silica, the average content of SiO₂ is 43% and for the younger formations it is 13%. The study area has an average of 44.62%. The average Al₂O₃ content of precambrian iron formations is 1.6%, whereas that of post-cambrians is 6.1% and study area is having a value of 0.35%.

The most striking difference between Precambrian and post-cambrian can very well be computed by the CaO content *i.e.* 1.5% and 14% respectively. The average CaO content of the study area is 0.70%. The average value of CaO/MgO ratio for Precambrian and post-cambrian and present area are 0.590, 8.0 and 0.595 respectively, which conforms that the study area BIF is similar to precambrians.

The P₂O₅ in precambrian iron formations is low, averaging 0.26% compared to an average of post-cambrian (0.86%). The study area is comparable with Precambrian with an average of 0.28. The content of MnO is three times greater in Precambrian than the younger iron formations. As compared to 0.009 of Mn/Fe ratio for post-cambrian, the study area BIF exactly fits to the Precambrian as it has an average of 0.028.

The depositional age of Sargur superacrustals must be older than 3400 Ma⁸ as they occur as enclaves within the polyphase trondhemitic to tonalitic gneisses, whose ages range

from 2.83 Ga to 3.4 Ga^{36,37}. As the BIF of the present area is enclosed by tonalitic gneisses and has been compared geochemically with Sargur BIF in the previous section, it may also be formed in the same age (*i.e.* 2.83 Ga to 3.4 Ga).

Chakarborty and Mujumder³ and Subba Reddy *et.al.*³⁸ found that the Eu/Sm ratio is very useful particularly in their age. The Eu/Sm ratio for the Precambrian BIF is older than 2500m.y. varies from 0.40 to 1.22; whereas the values for younger rocks vary from 0.24 to 0.40⁶. The Eu/Sm ratio of the study area BIF vary from 0.52 to 0.71, corresponding to Archaean values. In oldest iron formation of Isuva (3800m.y) the average La/Lu ratio is 24 with 9 – 52 in range. The 1800 m.y. old Ketilidian iron formations show an average La/Lu ratio of 94 with the range of 4.0 – 2.32. In the study area BIF show La/Lu ratio of 23.9 (range 11 – 43) corresponding to 3800m.y approximately.

Conclusion

The major elements concentration of the study area BIF is compared with various facies and noticed that these are of oxide facies of iron formations. The major, trace and REE concentrations are significantly different from the Algoma, Superior and Proterozoic BIF. Therefore the BIF of the study area has to be treated differently has been given separate type as Tamil Nadu Type. The transport of iron and silica are derived from mantle through hydrothermal solutions and fumarolic activity in submarine conditions and later metamorphosed. Though no direct radiometric age is available for the BIF of this study area, a combination of field and geochemical studies seems to establish that they are of Archaean age. The rare earth elements show close similarities in their concentration and distribution patterns to those in Precambrian BIF in various parts of the world. The Eu/Sm ratio of the study area indicates that the age of these rocks is greater than 2500M.Y and the La/Lu ratio conforms that these iron formations are of approximately 3800 M.Y. old.

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