Precambrian Iron-Formations

Iron-formation

- **Banded iron formations** (also known as **banded ironstone formations** or **BIF**s) are distinctive units of sedimentary rock that are almost always of Precambrian age.
- A typical BIF consists of repeated, thin layers (a few millimeters to a few centimeters in thickness) of silver to black iron oxides, either magnetite (Fe_3O_4) or hematite (Fe_2O_3), alternating with bands of iron-poor shales and cherts, often red in color, of similar thickness, and containing microbands (sub-millimeter) of iron oxides.
- Some of the oldest known rock formations, formed over 3,700 million years ago, include banded iron layers. Banded layers rich in iron were a common feature in sediments for much of the Earth's early history but are now rare. Phanerozoic ironstones generally have a different genesis.

Iron-formation facies

The sedimentary iron-formations of Precambrian age in the Lake Superior region can be divided on the basis of the dominant original iron mineral into four principal facies: sulfide, carbonate, oxide, and silicate. As chemical sediments, these rocks reflect certain aspects of the chemistry of the depositional environments. The major control, at least for the sulfide, carbonate, and oxide types, probably was the oxidation potential. The evidence indicates that deposition took place in restricted basins, which were separated from the open sea by thresholds that inhibited free circulation and permitted development of abnormalities in oxidation potential and water composition.The sporadic distribution of metamorphism and of later oxidation permits description of the primary facies on the basis of unoxidized, essentially unmetamorphosed material. The sulfide facies is represented by black slates in which pyrite may make up as much as 40 percent of the rock. The free-carbon content of these rocks typically ranges from 5 to 15 percent, indicating that ultra-stagnant conditions prevailed during deposition. Locally, the pyritic rocks contain layers of iron-rich carbonate. The carbonate facies consists, in its purer form, of interbedded iron-rich carbonate and chert. It is a product of an environment in which oxygen concentration was sufficiently high to destroy most of the organic material but not high enough to permit formation of ferric compounds. The oxide facies is found as two principal types, one characterized by magnetite and the other by hematite. Both minerals appear to be of primary origin. The magnetite-banded rock is one of the dominant lithologies in the region; it consists typically of magnetite interlayered with chert, carbonate, or iron silicate, or combinations of the three. Its mineralogy and association suggest origin under weakly oxidizing to moderately reducing conditions, but the mode of precipitation of magnetite is not clearly understood. The hematite-banded rocks consist of finely crystalline hematite interlayered with chert or jasper. Oolitic structure is common. This facies doubtless accumulated in a strongly oxidizing, probably near-shore, environment similar to that in which younger hematitic ironstones such as the Clinton oolite were deposited. The silicate facies contains one or more of the hydrous ferrous silicates (greenalite, minnesotaite, Stilpnomelane, chlorite) as a major constituent. Granule structure, similar to that of glauconite, is typical of some varieties; others are nongranular and finely laminated. The most common association of the silicate rocks is with either carbonate- or magnetite-bearing rocks, which suggests that the optimum conditions for deposition ranged from slightly oxidizing to slightly reducing.The relationship between the iron-rich rocks and volcanism, stressed by many authors, is considered by the writer to be structural, not chemical: in the Lake Superior region both iron-deposition and volcanism are believed to be related to geosynclinal development during Huronian time. In Michigan, the lower Huronian rocks are iron-poor quartzite and dolomite--typical "stable-shelf" deposits; much of the upper Huronian consists of iron-poor graywacke and slate with associated volcanic rocks--a typical "geosynclinal" assemblage. Thus the iron-rich beds of the middle Huronian and lower part of the upper Huronian were deposited during a transitional stage in structural history. The major environmental requirement for deposition of iron-formation is the closed or restricted basin; this requirement coincides in time with what would be a normal stage in evolution of the geosyncline; namely, structural development of offshore buckles or swells that subsequently develop

Types of Iron-formations

- **Algoma-types** are small lenticular iron deposits that are associated with volcanic rocks and turbidites. Iron content in this class type rarely exceeds 1010 tons. They range in thickness from 10-100 meters. Deposition occurs in island arc/back arc basins and intracratonic rift zones.
- **Superior-types** are large, thick, extensive iron deposits across stable shelves and in broad basins. Total iron content in this class type exceeds 1013 tons. They can extend to over 105 kilometers2. Deposition occurs in relatively shallow marine conditions under transgressing seas.
- **Rapitan-type**