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Geological record and sedimentology of the Palaeozoic oolitic ironstone deposits in Western Europe. Spatial relationships with the Linienbandkeramik settlements (LBK) in Belgium.

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Mined since prehistoric times, oolitic ironstones (OIS) were a very important world source of iron from 1850 to 1945: hereafter they have been progressively replaced by the Precambrian Banded Iron-Formations (BIF). OIS are iron-rich sedimentary rocks bearing ferruginous ooids. They consist of at least 15% iron. In Western Europe, their overall depositional environment is that of a shallow shelf, most often located close to the transition from non-marine to marine environments. Their main age range is concentrated within the Ordovician through Devonian and the Jurassic through Paleogene. Proterozoic occurrences are known but these occur outside Europe. The host rocks of the ironstones are predominantly clastic, whereas the host sediment of the ferruginous ooids can be either clastic or carbonate or both. The OIS occur at the top of coarsening and shoaling upward cycles. They represent condensed deposits and transgressive system tracts. Numerous oolitic ironstone deposits are interpreted as tempestites or as intertidal deposits.
It is generally agreed that ferruginous ooids formed in shallow marine water conditions, near the water-sediment interface, with repeated reworking of the sediment. Such an environment implies oxidizing conditions, the sedimentary iron being in the ferric state. The exact source of the iron is still a matter of discussion and speculation, just as the primary or secondary origin of the ferruginous ooids. Besides hematite (or goethite), also siderite, Fe-dolomite and berthierine/chamosite are present in the OIS as iron-bearing minerals. Due to weathering processes the carbonate matrix is often removed, the iron is released and oxidized, whereas the ferrous silicates are converted into ferric oxides or ferric hydroxides. Many old mining activities are based on occurrences of this weathered ore. The latter material has also strong staining properties.

1. Germany

OIS are outcropping in the Eifel area. The latter is part of the Ardenno-Rhenish Massif and lies in the eastern extension of the Neufchateau Synclinorium, south of the Ardenne Anticlinorium (enclosing the Cambro-Ordovician Stavelot-Venn inlier). The general structure of the Eifel corresponds to an intensively folded and faulted synclinorium In the center of this synclinorium, outcrops of OIS occur on both flanks of successive synclines that are individually named (from the north to the south): the Sötenicher Mulde, the Blankenheimer Mulde the Rohrer Mulde, the Dollendorfer Mulde, the Ahrdorfer Mulde and the Hillesheimer Mulde. Two important stratigraphic levels with IOS are known and they coincide more or less with the Lower-Middle Devonian boundary (Uppermost Emsian-Lowermost Eifelian). These OIS represent excellent marker beds for geological mapping.

2. The Netherlands

There is no outcrop of OIS in this country.

3. Belgium

Oolitic iron ores were formed during different periods in Belgium: the Lochkovian (Lower Devonian, Dinant Synclinorium, restricted to the Belgian-French border), the Givetian (Middle Devonian, Dinant Synclinorium), the Frasnian (Upper Devonian, Dinant Synclinorium), the Famennian (Upper Devonian, Namur S., Dinant S. & Vesdre S.) and the Toarcian-Aalenian (Jurassic, Lorraine area, Paris Basin – called “minette ore”). The most important OIS level is the Lower Famennian one. It has been intensively mined until the middle of the 20th century, essentially in the Namur Synclinorium, between

the cities of Namur and Huy. In this area, its important thickness (until 1.85m) and the number of layers triggered the development of an important economic activity. Outcrops were restricted to the tributaries of the Meuse River. The Famennian oolitic ironstone facies change from north to south by a gradual decrease in the number of layers, in their thickness, grain size, ooid concentration, clast size and iron content. They represent also excellent lithostratigraphical marker beds. The clay-dolomitic matrix is being progressively replaced by a calcitic cement. The other Devonian OIS levels are not of great economic importance, they were only mined locally, to supply smith's working places. Due to surface mining, outcrops are now very rare, and often indicated by a light depression in the topography only.

4. Grand-Duchy of Luxembourg

OIS are restricted to the Jurassic (Aalenian-Lower Bajocian) in the NW part of the Paris Basin. This essentially goethitic ore ("minette") was intensively mined in the three adjacent country borders area (FR-BE-LU). No OIS levels in the Lower Devonian are outcropping in the northern part of the Grand Duchy.

5. France

Numerous OIS layers are known in France at several stratigraphical levels, but a lot of them cannot be considered as a real ore. Paleozoic OIS belonging to the Armorican Massif were mined in the Normandy area (Urville Fm, Llanvirn, Middle Ordovician) and in the Bretagne area (Arenig, Lower Ordovician). In Normandy, OIS do outcrop inside several synclines (*e.g.* May and Urville Sy.), as one thick composite layer.

The spatial relationships of the different oolitic ironstone levels with the Linienbandkeramik settlements (LBK) in the studied area, will be presented.