IRON ORE

Iron Species and Gangue Mineralogy Mapping

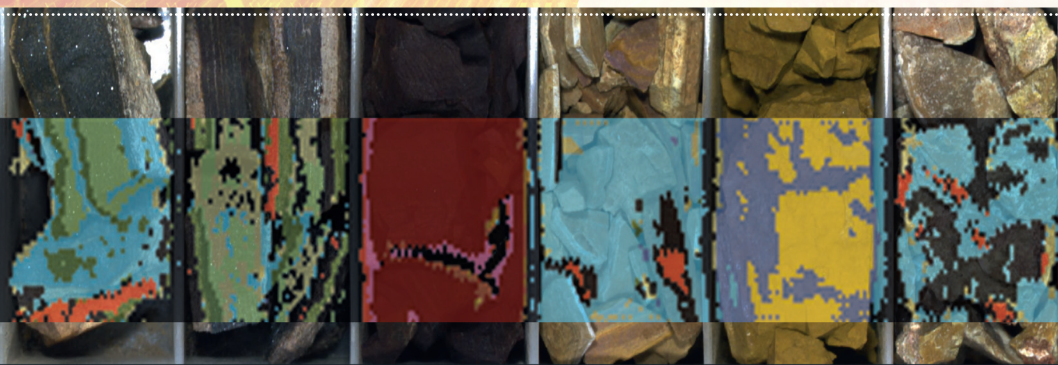
Automated Hyperspectral Logging

The successful development of iron ore resources is fundamentally linked to our ability to accurately identify not only multiple species of iron oxide minerals, but also sub-species, phases (eg. ochreous vs. hard) and associated gangue minerologies. Beneficiation of iron ore is ultimately guided by this inherent mineralogy as well as secondary properties such as grain size, impurities and grindability.

Corescan's HCI-3 integrates reflectance spectroscopy, core photography and 3D laser profiling to map these species and phases offering automated quantitative mineralogical, geochemical and textural information, used during both exploration and process studies for a deposit. The high sensitivity, high resolution spectral and spatial sampling of HCI-3 identifies and maps not only primary iron oxides (hematite, magnetite, goethite, martite, etc.), but also typical gangue assemblages such as kaolinite, smectites, silicates and gibbsite.

Rapid, consistent mapping of ore samples (both cuttings and core) provide both the geologist and metallurgist with comprehensive digital records of drill holes that can be sent electronically to any number of geological experts or consultants and brought into a myriad of software packages for further analysis and synthesis.

HCI-3 complements the geologist's own qualitative assessment of core/cuttings with detailed, quantitative and timely mineralogical information.



Typical iron ore lithologies with corresponding high resolution HCI-3 mineral maps

The Hamersley Range: World Class Iron Ore District

The iron ore deposits of the Pilbara in Western Australia are exemplified by archetypal Banded Iron Formation (BIF), Bedded Iron Deposits (BID), Channel Iron Deposits (CID) and Detrital Iron Deposits (DID). The ore examples shown here are from the Fortescue Metals Group (FMG) - Solomon Hub where Lower Proterozoic Hamersley Group sedimentary sequences (typified by outcropping Brockman Iron Formation) spatially constrain ore-rich palaeochannels cut into flat laying basement rock.

All three deposit types (BID, CID and DID) in the Solomon Hub are economic, but close tracking of phase (ochreous vs. hard mineralogy) and gangue mineralogy (kaolinite, smectite, silica etc.) is critical for economic extraction and processing by FMG.

Class Map Colour Index:

- Hematite – Ochreous
- Hematite – Red
- Hematite – Grey
- Hematite – Shale
- Martite
- Martite – Hydrohematite
- Martite – Goethite
- Goethite – Ochreous BID
- Goethite – Ochreous CID
- Goethite – Vitreous, Hard
- Goethite – Vitreous, Glassy
- Magnetite
- FeOx + Gangue
- Non Iron Ox mineral

Typical assemblage of iron ore minerals. These minerals are mapped spatially in the core at left. Note identification of not only species, but texture and phase.

Identification and Mapping of Iron Ore Mineralogy

The various species, sub-species and phases of iron oxides are readily recognizable to the human eye due to the obvious colour, texture and lustre differences, however, due to alteration at time of mineralisation, the ore is typically mixed at fine scales and frequently contains hard-to-classify impurities such as clay and silica. Furthermore, logging these mineralogic changes in core (and especially cuttings) proves more often than not, inconsistent and inefficient.

The mineralogy (both primary iron oxides and secondary alteration) measured by the HCI-3 in the core and cuttings from the Solomon Hub is able to identify mineralogical and textural variability that will assist FMG in optimising mineral processing and in designing future expansion work.

This variability is recorded in not only detailed image classification maps , but also finely sampled, quantitative databases of downhole mineralogy that are easily merged into existing software packages for deposit and process modeling.

FROM	TO	DEPTH	HEMATITE TOTAL	GOETHITE TOTAL	MARTITE TOTAL	KAOLINITE TOTAL	NONTRONITE TOTAL	NON FeOX	HEMATITE OCHREOUS	HEMATITE RED	HEMATITE GREY	HEMATITE SHALE	MARTITE	MARTITE VGH	MARTITE GOETHITE	GOETHITE BID	GOETHITE CID	GOETHITE GOH	GOETHITE GGM
-7.7	-7.8	7.75	0.248	0.473	0.004	0.09039	0	0.21787	0.02213	0.22561	0	0	0.00026	0.00045	0.00284	0.42787	0.04516	0.00006	0.00013
-7.8	-7.9	7.85	0.256	0.340	0.016	0.00276	0	0.26526	0.02173	0.23417	0.00013	0.00013	0.00013	0.00141	0.01487	0.27981	0.05045	0.00474	0.00506
-7.9	-8	7.95	0.344	0.198	0.009	0.00442	0.00051	0.32487	0.01391	0.32962	0	0	0.0009	0.00064	0.00782	0.16122	0.03692	0	0
-8	-8.1	8.05	0.549	0.106	0.043	0.23928	0.00179	0.21944	0.0097	0.53876	0.00005	0.00005	0.00306	0.0325	0.00703	0.08134	0.021	0.00199	0.00131
-8.1	-8.2	8.15	0.714	0.084	0.008	0.42718	0	0.13568	0.00202	0.71238	0	0	0.00077	0.0029	0.0048	0.07494	0.00899	0	0
-8.2	-8.3	8.25	0.580	0.201	0.018	0.4517	0.00074	0.1184	0.01827	0.56167	0.00003	0.00006	0.00526	0.00747	0.00481	0.15176	0.0491	0.00026	0
-8.3	-8.4	8.35	0.375	0.381	0.008	0.34625	0.00096	0.1842	0.02308	0.35192	0.00006	0.00003	0.00135	0.00343	0.0033	0.2834	0.08933	0.00237	0.00612
-8.4	-8.5	8.45	0.526	0.269	0.003	0.36808	0.00003	0.13439	0.0249	0.50071	0	0	0.0001	0.00119	0.0016	0.20506	0.06131	0.00183	0.00074
-8.5	-8.6	8.55	0.406	0.267	0.003	0.47119	0	0.18176	0.00087	0.40487	0	0	0	0	0.00317	0.22853	0.03833	0	0
-8.6	-8.7	8.65	0.328	0.132	0.030	0.47853	0.00013	0.39779	0.00054	0.32785	0	0	0.00048	0.02869	0.00048	0.11397	0.01753	0	0
-8.7	-8.8	8.75	0.321	0.247	0.061	0.15177	0.00031	0.26917	0.01062	0.31006	0.00014	0.00037	0.00092	0.05932	0.00092	0.23261	0.01259	0.00048	0.00149
-8.8	-8.9	8.85	0.185	0.570	0.002	0.06122	0.00003	0.17256	0.04196	0.14029	0.00147	0.00131	0.00048	0.00022	0.00141	0.45458	0.08115	0.01346	0.0209
-8.9	-9	8.95	0.245	0.594	0.003	0.03699	0	0.14862	0.08391	0.15862	0.00054	0.00189	0.00006	0.00115	0.00189	0.39519	0.12686	0.05301	0.01846
-9	-9.1	9.05	0.286	0.491	0.021	0.14539	0.00007	0.16246	0.02382	0.26083	0.00051	0.00073	0.00356	0.01593	0.00158	0.35322	0.10876	0.01483	0.01409
-9.1	-9.2	9.15	0.180	0.727	-	0.12808	0	0.08942	0.06019	0.1075	0.00442	0.00782	0	0	0	0.36436	0.12859	0.16853	0.06538
-9.2	-9.3	9.25	0.580	0.362	0.003	0.24019	0.00032	0.05353	0.26756	0.19577	0.00212	0.11455	0.00006	0.00282	0	0.12038	0.0941	0.12801	0.02
-9.3	-9.4	9.35	0.797	0.168	-	0.60756	0	0.03558	0.2959	0.02442	0.00192	0.47449	0	0	0	0.05885	0.02968	0.0566	0.02256
-9.4	-9.5	9.45	0.478	0.198	0.005	0.45029	0	0.29793	0.23411	0.23974	0	0.00437	0.00161	0.00357	0	0.12853	0.06507	0.00286	0.0017
-9.5	-9.6	9.55	0.824	0.132	0.002	0.87147	0.00013	0.02744	0.36699	0.45231	0	0.00468	0.0016	0.00083	0	0.06513	0.06276	0.00346	0.00103
-9.6	-9.7	9.65	0.878	0.102	0.001	0.98538	0	0.00821	0.12724	0.75045	0	0.00006	0.00096	0.00013	0.00026	0.06577	0.03494	0.00038	0.0009
-9.7	-9.8	9.75	0.661	0.038	0.131	0.55188	0	0.10812	0.05234	0.80876	0	0	0.00436	0.12539	0.00109	0.01581	0.02181	0	0.00018

Quantitative down-hole mineralogy derived from percentages of identified and mapped minerals (calculated per 1m). Such data easily integrates into any process or ore modeling software as simply X-Y data.

All data courtesy of:

FMG Fortescue
The New Force in Iron Ore

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