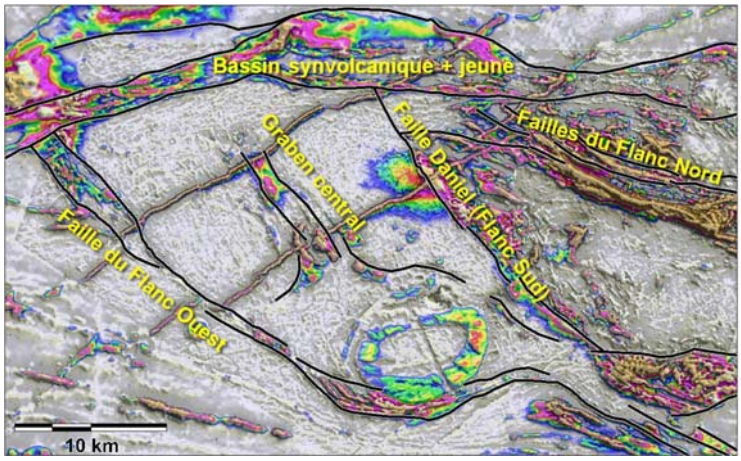
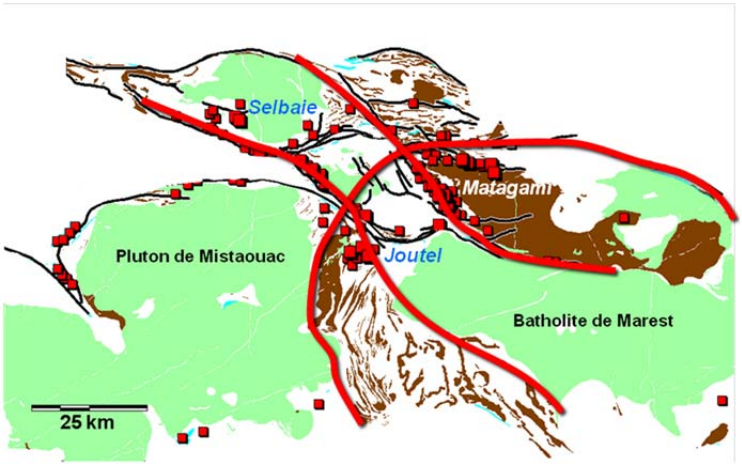
2009-04: Identification of major synvolcanic structures in VMS environments, Abitibi Subprovince

The majority of faults and deformation corridors in the Abitibi are considered to be orogenic structures. If this view is compatible with the presence of visible ductile deformation within these faults, it does not exclude the possibility that the structures were initiated very early in the geological history of a given region. This conceptual project is based on the principle that the architecture of the volcano-sedimentary stacks of a region of the Abitibi is the result of primary synvolcanic organisation that was subsequently modified by deformation.



A – Interpreted synvolcanic faults in the Matagami mining camp on a map of residual magnetic field in colour and the first vertical derivative in transparency.

The volcanic architecture of northwestern Abitibi is tested using this method, with a special emphasis on the zinc-bearing Matagami and Selbaie mining camps. The project also gives added value to existing geological and lithogeochemical data, as well as to recent magnetic and gravity surveys from the area.



B - Reconstitution of the synvolcanic architecture in NW Abitibi between 2720 and 2730 Ma.

It is proposed that the North, South and West flanks of the Matagami camp are separate entities representing synvolcanic faults along the borders of grabens (**figure A**). These faults stand out on the high-resolution aeromagnetic survey maps by the presence of rhyolites, by an abundance of felsic calc-alkaline dikes and by easily identifiable magnetic mafic dikes. In addition, the South flank is characterised by a family of interpreted synvolcanic faults at 30-40 degrees to the Daniel Fault. These faults are highlighted by the alignment of massive sulphides, abrupt changes in the attitude of the Clef Tuffite, breaks in rhyolitic units or changes in their thickness, demagnetisation, and typically volcanogenic alteration (alkali leaching and iron enrichment according to mass balance calculations using modelled precursors; project 2009-01). Interpretation of aeromagnetic and ground-based gravity surveys serves to underscore a major NW-oriented structure between the South and West flanks. The structure consists of a dike corridor and small dioritic intrusions. It is interpreted as one of two feeder conduits for the McIvor synvolcanic intrusion and as a synvolcanic structure defining two buried mafic intrusions to the east whose gravimetric signature is similar to that of the synvolcanic Bell River Complex. The structure supports the idea of a graben-type extensional zone. The South flank and

Daniel Faults are cut to the north by a strongly magnetic, linear and narrow synvolcanic basin, 3 to 10 km by 100 km in size, oriented E-W and strongly magnetic. The interior of the basin is documented via drilling to contain felsic calc-alkaline volcanics, massive sulphides and layers of exhalites (tuffite).

Using the same arguments, synvolcanic faults are also proposed in the Selbaie mining camp west of Matagami. These faults surround an area of rhyolites and andesites of calc-alkaline affinity, located on either side of the synvolcanic Brouillan intrusion that is also calc-alkaline. The vertical gradient of the Bouguer anomaly (helicopter-borne survey DP 2008-02) shows that negative anomalies correspond to a narrow basin of felsic volcanics elongated ESE and to two feeder conduits under the Brouillan intrusion. A system of secondary synvolcanic faults oriented NE-SW cut the Selbaie basin, whose main representative is Zone B from the former Selbaie mine.

The geometry and the relative chronology between the interpreted synvolcanic faults in the NW Abitibi allow a reconstruction of the architecture of faults and volcanic arcs between approximately 2720 and 2730 Ma (**figure B**). The reconstruction is enabled by eliminating the sedimentary basins and by restoring the position of the blocks before the proposed movements along the faults. One of the proposed scenarios is that the Joutel mining camp (Zn-Cu) was juxtaposed with the West flank at Matagami and the southern edge of the Selbaie basin would then be an extension of the flank to the NW. The NE margin of the calc-alkaline volcanic and plutonic Selbaie complex could be part of the NW continuity of the South flank of Matagami. This kind of conceptual modelling can generate new exploration strategies for massive volcanogenic sulphides in this sector.

Project 2009-04: Summary	
Objectives	• To propose new areas for VMS exploration in northwestern Abitibi using a conceptual approach.
Innovation	• Integration of geology, geochemistry and geophysics to identify synvolcanic faults on a regional and mining camp scale and to establish a paleovolcanic reconstruction.
Results	• A paradigm shift: the deformation corridors in the Abitibi are considered to be a volcanogenic legacy rather than an orogenic imprint. It suggests that most of the faults could host VMS-type mineralisation. • Regional integration of the Matagami, Joutel and Selbaie mining camps into a caldera and graben model comparable to the Rouyn-Noranda model.