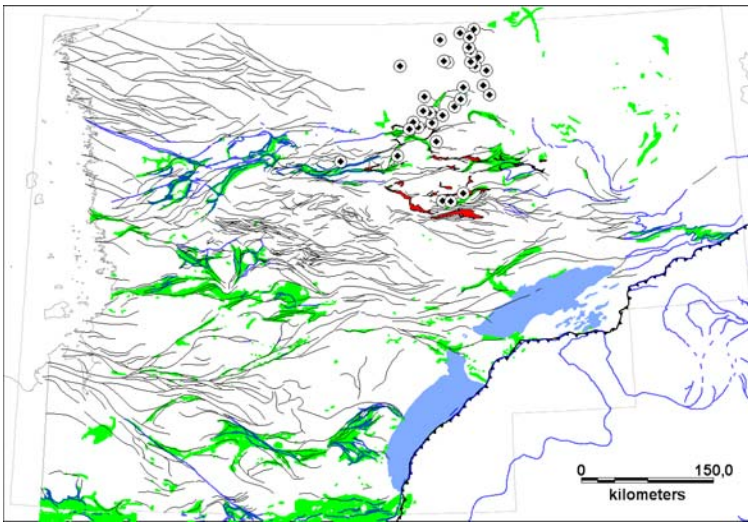
2009-10: Crustal permeability in Northern Quebec and exploration guides for gold, uranium and diamonds

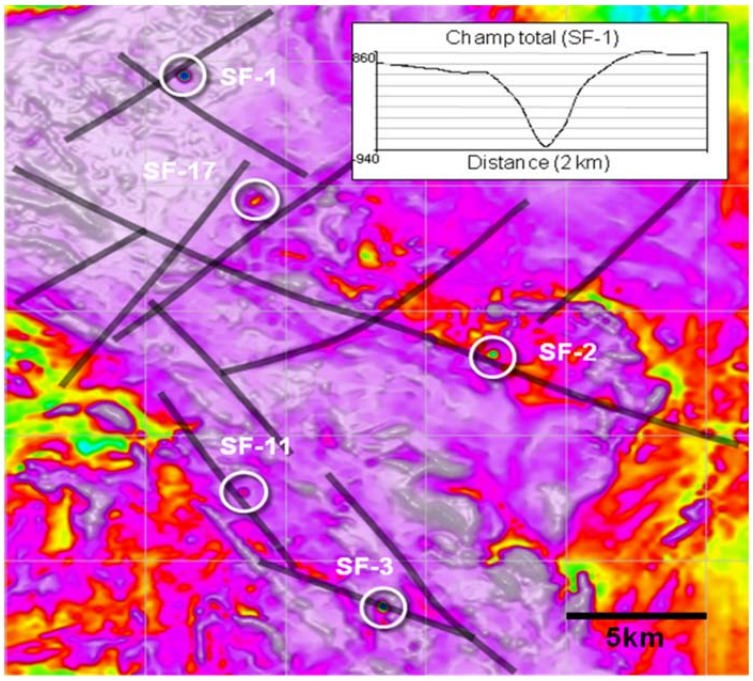
A study of magnetic and topographic lineament interpretation is presented for an area of Northern Quebec (James Bay). It aims to establish new vectors for different types of mineralisation.

Interpretation of recent airborne magnetic surveys in the northern area of this region (**figure A**) helped identify new iron formation segments (62) and possibly small greenstone belts (30 slivers) or extensions of greenstone belts. The surveys were also used to target 33 circular and contrasting magnetic anomalies, a few hundred metres in diameter and very similar to the geophysical signature of known kimberlites in the Slave Province and elsewhere in the world (**figure B**). This new field of kimberlitic anomalies, similar in size to Lac De Gras in the Slave Province, is located under a Mesoarchean mantle and around one of the cratonic roots of the Superior Province whose depth is in the diamond stability field.

Hundreds of magnetic lineaments classified as deformation lineaments are interpreted as Archean deformation corridors. They were traced intersecting both greenstone belts and Laguiche-type sedimentary basins (host to the Éléonore deposit). These lineaments are placed in spatial relationship with known or interpreted orogenic gold mineralisations and greenstone belts. The intersection of these lineaments with greenstone belts and iron formations is considered to be a regional metallotect because 77 % of known gold showings and deposits in this region are associated with deformation corridors in the greenstone belts. One type of lineament that



A- Potential targets in the James Bay area for new greenstone belts (in red) and a new kimberlite field (black circles with diamonds) with interpreted magnetic deformation lineaments (black lines), and ductile faults (in blue) and greenstone belts identified from SIGÉOM (green).



B - Typical negative magnetic signatures of kimberlite targets in high-grade metamorphic terrains north of the James Bay territory on the total magnetic field (RP2009-01). Intersecting magnetic lineaments (black lines) and the magnetic profile of one of the 33 targets.

defines distinct magnetic domains helped identify early folded N-S structures, which are cut by generally E-W deformation lineaments.

The straight lineaments cut the magnetic fabric clearly and are visible in topographic features. They are interpreted as ductile-brittle or brittle faults. The various interpreted families of structures generally coincide with the orientation of Proterozoic diabase dike networks. These structures are probably contemporaneous with the pan-cratonic magmatic events. Some of the families cut Proterozoic uranium-bearing basins, whereas one other is older than the Otish Basin (basement faults), establishing a relative chronology and a guide for uranium exploration, especially for the N-S Matoush-type structures. One family of lineaments is oriented ENE and is spatially associated with the Vaujours Fault and especially with Cu-U polymetallic mineralisation. It is interpreted to be the distal expression of a failed rift of the Labrador Trough (Cambrian lake rift).

This interpretation of the geophysical lineaments that evenly cover the entire northern region established a new structural representation. Despite a high grade of metamorphism, the structural style of the deformation lineaments compares in orientation and frequency to the major faults of the Abitibi.

Project 2009-10: Summary	
Objectives	• To develop a method for identifying magnetic lineaments in high-grade metamorphic terrains. • To generate exploration targets for orogenic gold, uranium and diamond exploration in the James Bay region.
Results	• Potential targets: 30 new small greenstone belts representing 911 km^2, 62 new segments of iron formation totalling 331 linear km, 33 circular anomalies typical of kimberlites. • New representation of Archean ductile structures (deformation corridors) and Proterozoic brittle structures (faults and diabases).
Innovations	• Methodology for identifying geophysical lineaments in high-grade metamorphic terrains.
Special Collaboration	• Réal Daigneault (interpretation and characterisation of magnetic lineaments).