Makada Property:

Potential Offset Dyke Discovery in the Waters Township

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1.0 Location

This brief report describes the one-day surface sampling program completed by M.Sc Geology student Adam Coulter supervised by Dr. Gordon Osinski on June 26, 2014. In 2007, Walter Peredery was the first to identify the nearby dyke as a possible Quartz Diorite (QD) dyke related to the Sudbury impact structure based on field observations and thin section analysis. In 2011, Cecil Johnson and Rob Foy completed four days of field investigations to determine the nature and extent of the potential QD phase.

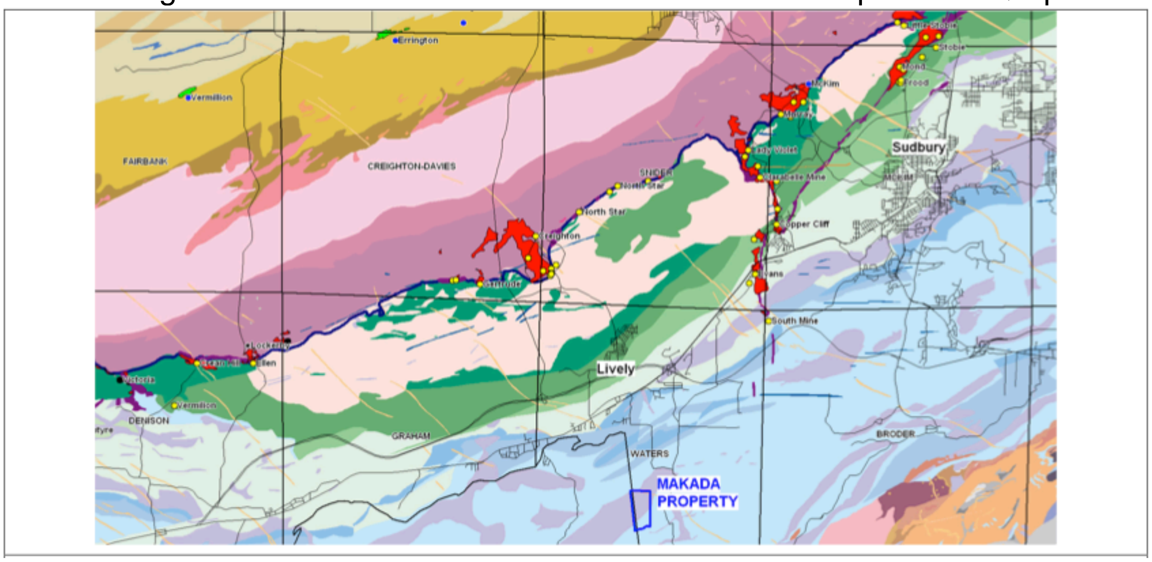

Figure 1: The Makada Property lies ~ 9 km into the footwall of the Sudbury Igneous Complex, beyond the South Range breccia belt (Foy and Johnson, 2011).

2.0 Observations

Six surface samples were collected on June 26, 2014 near the previous workings of Walter Peredery, Cecil Johnson and Rob Foy. The goal of the sampling was to confirm whether or not the Makada Property does indeed contain any of the offset dike lithologies related to the Sudbury impact structure. Three thin section slabs were prepped by the author, then sent to Vancouver Petrographics Ltd. and a follow up petrographic study was completed by research assistant, Nicola Barry. Six samples were powdered and sent to ALS laboratories for a full geochemical suite.

Name	Position	Altitude	Date Modified	TS	XRF
5015518	17 T 489867 5136804	839 ft	6/26/2014 9:40:04 AM		x1
5015519	17 T 489862 5136790	855 ft	6/26/2014 9:49:47 AM		x1
5015520	17 T 489838 5136741	884 ft	6/26/2014 10:04:44 AM		x1
5015521	17 T 489673 5136686	945 ft	6/26/2014 10:18:43 AM	x1	x1
5015522	17 T 489640 5136667	958 ft	6/26/2014 10:26:03 AM	x1	x1
5015523	17 T 489439 5136534	936 ft	6/26/2014 10:42:48 AM	x1	x1

Table 1: Sample Locations displayed in UTM NAD 83, Zone 17N. TS = thin section, XRF = X-ray Fluorescence analysis.

Figure 2: Samples locations on a satellite image. Scale bar is 399 m.

Figure 3. Closer view of sample locations on a satellite image. Scale bar is 169 m.

The hand specimens collected do indeed resemble the so-called “quartz diorite” (QD) phase of the offset dikes related to the Sudbury impact structure. The Offset dikes occur as radial, concentric and discontinuous bodies around the Sudbury Igneous Complex, most are actually granodioritic to monzodioritic in composition (Wood and Spray, 1998). The samples collected were described in field as roughly equigranular, fine- to medium-grained rock with a groundmass composed of ~10% quartz, ~30% feldspar, ~40% amphibole, ~5-10% pyroxene with minor sulphides. Some samples contained small ~1cm in diameter quartzite inclusions, which are likely locally derived from the

Mississagi Formation. A finer-grained chilled contact was observed with the country rock near sample 5015523.

3.0 Geochemistry

The Makada Property shows very different geochemical properties to the known Offset dykes in the Sudbury impact structure (fig. 4-7). As shown in Lightfoot et al. (1997), the Offset dykes display a remarkably homogenous REE pattern, even in the distal portions of the structures. The Makada Property samples display an enrichment in LREE in comparison with the other four noted Offset dykes from around the SIC: Copper Cliff, Foy, Ministic and Worthington (fig. 4). In addition, the Makada property does not display the typical low Eu and higher Gd trend seen in all other Offset dykes (fig. 4). Figure 5 compares the Makada Property data to the average SIC, granophyre, Felsic Norite and local Matachewan and Nippissing diabase dykes, again the REE pattern is highly enriched in LREE and depleted in HREE in comparison. The Makada Property shows a difference in metal abundances compared with other known Offset dykes (fig. 6). Finally, we plot the Makada Property data on a simple TAS Plutonic diagram to give a geochemical estimate for a rock name, the data suggests the rock is gabbroic rather than the dioritic Offset dykes (fig. 7).

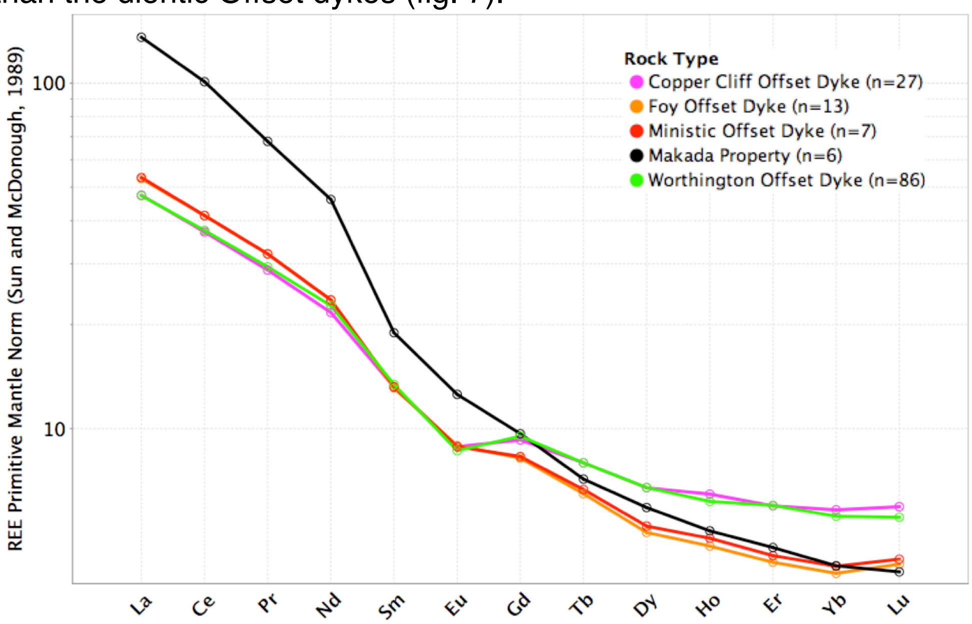

Figure 4. REE Primitive Mantle Normalized Spider Diagram (Sun and McDonough, 1989). The Makada Property data is from this study and all other Offset dyke data is from Lightfoot et al. (1997).

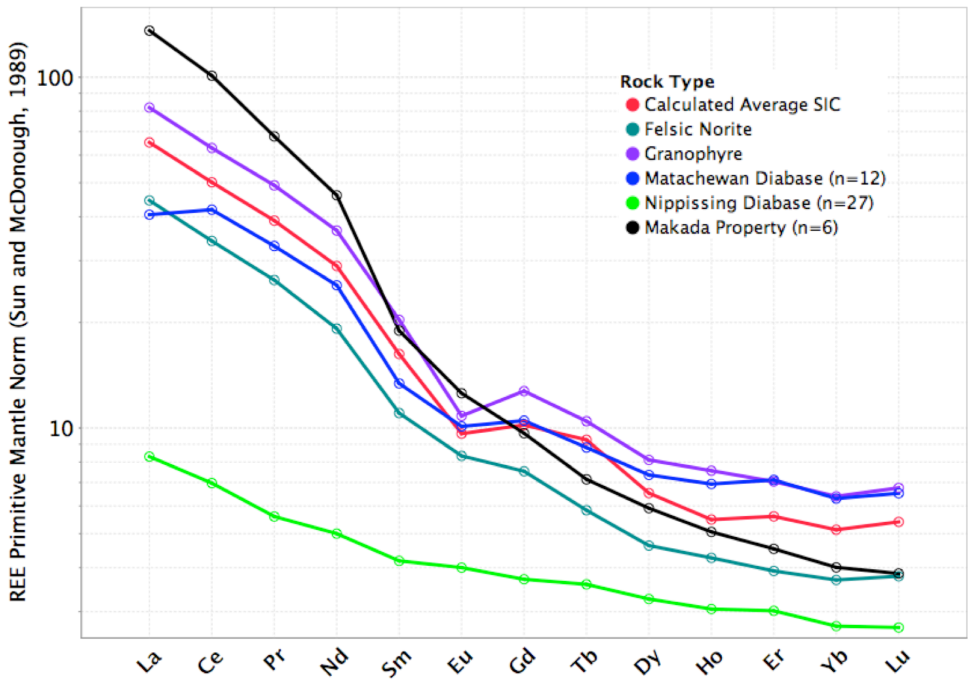

Figure 5. REE Primitive Mantle Normalized Spider Diagram (Sun and McDonough, 1989). Makada Property data from this study, calculated average SIC, Felsic Norite, Granophyre data from Lightfoot et al. (1997) and the Matachewan and Nippissing Diabase data is from an internal database of regional Sudbury geochemistry.

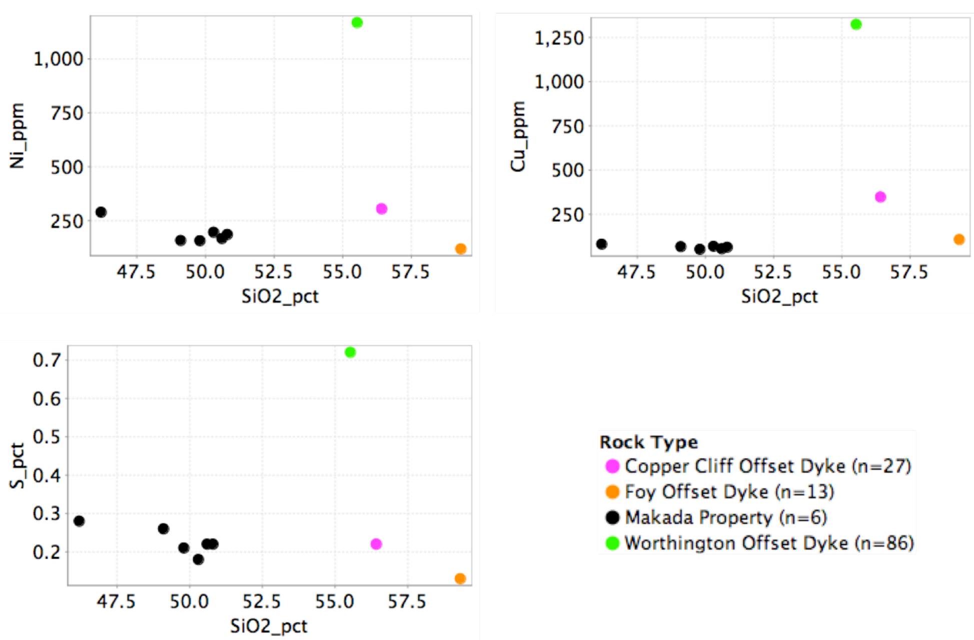

Figure 6. SiO2 vs Ni, Cu and S abundance for Makada Property and three other Offset dykes.

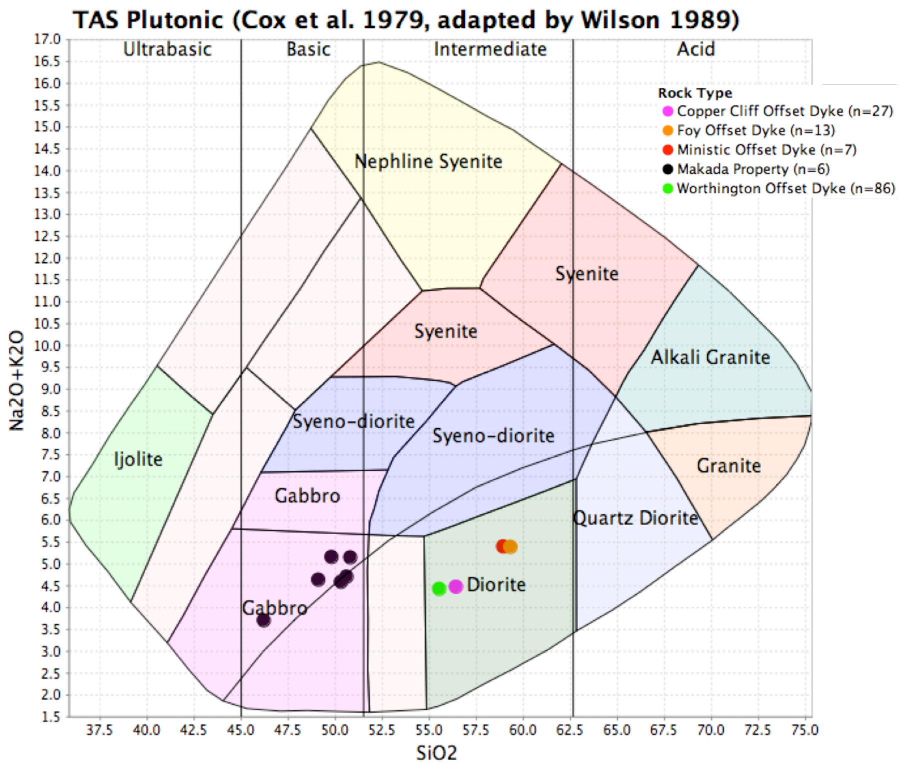

Figure 7. TAS Plutonic Rock Classification Diagram (Wilson, 1994) displaying Makada Property data with known Offset Dyke compositions.

4.0 Petrology

Petrology was completed by research assistant, Nicola Barry. Samples 5015521-5015523 are medium grained altered gabbroic rock with subophitic texture. The major minerals are plagioclase, clinopyroxene, amphiboles, biotite, and opaques. Minor minerals include olivine, orthopyroxene, actinolite, sulfides and opaques. Sericitic and chloritic alteration is pervasive throughout the samples, and appears as a brownish green aphanitic clay (See Figure 2). The plagioclase laths vary greatly in size and appear in clusters and masses of interlocking grains. Sample 5015522 has several large grains of euhedral blocky plagioclase with oscillatory zoning, mermyketic texture, and alteration in center of grains. Sample #5015523 is very fine grained (chill margin). This sample has several coarse grained clinopyroxene crystals (~2mm) that are weathered and have much smaller minerals forming within their boundaries (see Figure 5 and 6).

Mineral	**%**	**Grain size (mm)**	**Comments**
Plagioclase	45	0.2 - 3	Interstitial plagioclase laths vary greatly in length and width. They sometimes occur in clusters. The majority are long and slender, with most showing albite and pericline twinning, and a few larger grains showing oscillatory zoning, simple twinning also visible. Most of the plagioclase laths have been partially sericitized along the outer edges of the grain or the centers of the larger grains.
Clinopyroxene	20	0.2 – 2.5	Anhedral grains that have been highly sericitized.

Orthopyroxene	3	0.2 – 1	subhedral-anhedral grains
Amphiboles	20	0.2 - 1	Subhedral grains partially altered to chlorite
Biotite	5	0.2 - 1	Subhedral grains mostly altered to chlorite
Opaques	3	<0.1 - 2	Anhedral to subhedral,
Olivine	1	0.5 - 1	Euhedral grains fractured and sericitized
Unknowns	3	<0.2	Multiple very fine grained minerals throughout sample

Table 2. Petrographic descriptions and model mineralogy of samples 5015521, 5015522 and 5015523.

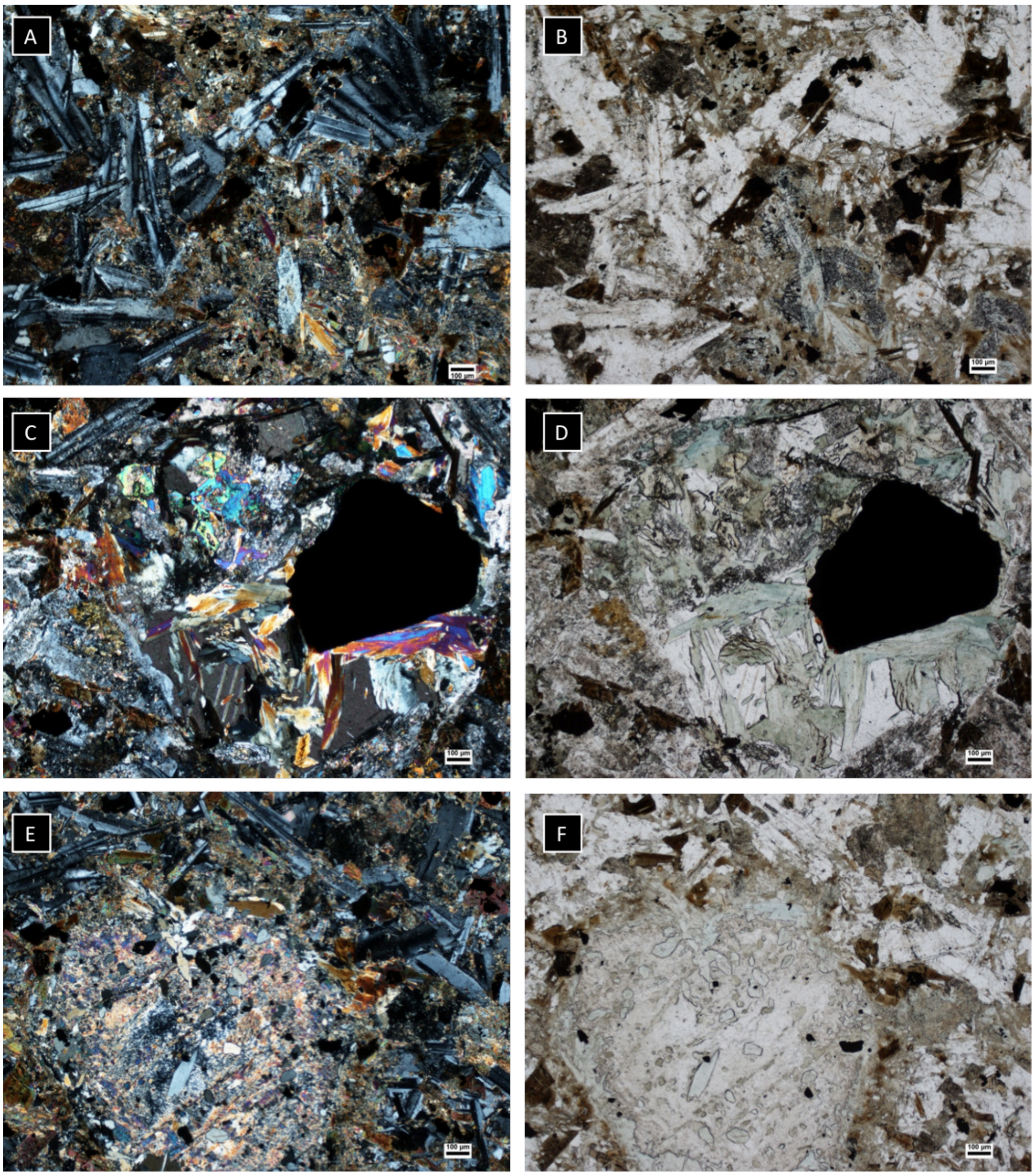

Figure 8. A) Sample 5015521, XPL photomicrograph of euhedral plagioclase laths with overprinting sericitization and chloritization. B) PPL photomicrograph of A. C) Sample 5015522, XPL photomicrograph of anhedral sulphide mineral set in groundmass. D) PPl photomicrograph of C. E) Sample 5015523, XPL photomicrograph of completely sericitized cpx grain. Some visible biotite around grain. F) PPL photomicrograph of E.

5.0 Conclusions

The geochemical portion of this study suggests the rocks located on the Makada Property are not related to the Offset Dykes in the Sudbury impact structure (fig. 4-7). Although the outcrops appeared quite similar, the REE geochemistry would prove otherwise (fig. 4-5) as all of the known Offset dykes display similar REE patterns (Lightfoot et al., 1997). Figure 7 suggests the rocks located on the Makada Property are more gabbroic in nature rather than a diorite. This is consistent with the petrology which also suggests this rock to be gabbroic in nature, rather than a quartz diorite.

References

Foy, R. and Johnson, C., “Geotechnical Report Surface Sampling & Beep Mat work Makada Property”. Foy Geological Services, 2011.

Lightfoot, P. C. et al., “Geochemical relationships in the Sudbury igneous complex; origin of the main mass and offset dikes.” *Economic Geology* 92.3 (1997): 289-307.

Middlemost, E.A.K., “Naming materials in the magma/igneous rock system.” *Earth-Science Reviews* 37.3 (1994): 214-224.

Sun, S.S., and McDonough, W.F. "Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes." *Geological Society, London, Special Publications* 42.1 (1989): 313-345.

Wood, C. R., and Spray, J.G., "Origin and emplacement of offset dykes in the Sudbury impact structure: Constraints from Hess." *Meteoritics & Planetary Science* 33.2 (1998): 337-347.