"THE LABRADOR URANIUM AREA"[1]

Greg Sparkes, Mineral Deposits Section

SUMMARY

Ongoing exploration within the Central Mineral Belt (CMB) region of Labrador continues to produce new discoveries of uranium mineralization in both previously known and entirely new areas of the belt (Figure 1). Numerous new occurrences have been identified in the underlying Archean basement rocks highlighting the importance and potential of these units within the region. Recent discoveries of uranium mineralization within the overlying Moran Lake Group along strike from the Moran Lake C Zone deposit indicates the potential for significant uranium mineralization outside of the historically defined occurrences. Newly defined resources for the Inda, Gear and Nash deposits, which are hosted within the Post Hill Group in the eastern portion of the CMB, demonstrate the potential for the expansion of historical occurrences, both along strike and at depth within the mineralized corridor. Elsewhere, the discovery of mineralized equivalents of the Post Hill Group in the region of Anna Lake further highlights the regional potential of this group.

Volcanic rocks of the Aillik Group continue to be the most prolific hosts to known uranium mineralization within the CMB. Examination of coastal exposures confirm the potential for further significant uranium mineralization within areas currently exempt to mineral exploration. In more western portions of the CMB, basal sedimentary sequences of the Bruce River Group continue to demonstrate the potential for sediment-hosted uranium mineralization; while the overlying felsic volcanic succession continues to be explored for volcanic-hosted styles of mineralization.

The Labrador region, and more specifically the CMB, is currently host to approximately 58,000 tU. Exploration within the Labrador region has expanded historical resource estimates within the Michelin and Moran Lake C Zone deposits, and identified new resources such as the Jacques Lake and Two Time deposits. Uranium occurrences within the CMB have been categorized into broadly magmatic, metamorphic–metasomatic and sedimentary environments (Sparkes and Kerr, 2008). This current classification of uranium mineralization within the CMB is based on an ever expanding knowledge base, and attempts to incorporate the vast amount of new information being generated by the many companies active in the region. As a result, the classification presented here represents current interpretations, but is subject to change as new data become available.

URANIUM ENVIRONMENTS OF LABRADOR

Syn-Plutonic Mineralization

Uranium mineralization hosted within Archean basement rocks represent some of the oldest mineralization known to date within the region. This mineralization occurs as synmagmatic uranium enrichment within meter-scale pegmatitic dykes and sheets of leucocratic granite, which intrude surrounding gneissic rocks; these pegmatites have locally been dated at ca. 1870 Ma (Ketchum *et al.*, 2001). These intrusions are locally associated with a pale yellow weathering which corresponds with areas of elevated radioactivity (e.g. Dandy prospect, Plate 1; Figure 1). The gneissic host rocks are relatively barren with respect to uranium mineralization, aside from anomalous radioactivity developed immediately adjacent to the intrusions (e.g. Stomach Lake prospect, Plate 2; Figure 1). Although grabs samples from these occurrences have returned assay values of up to 0.18% U_3O_8, the limited drilling carried out to date has shown the mineralization to

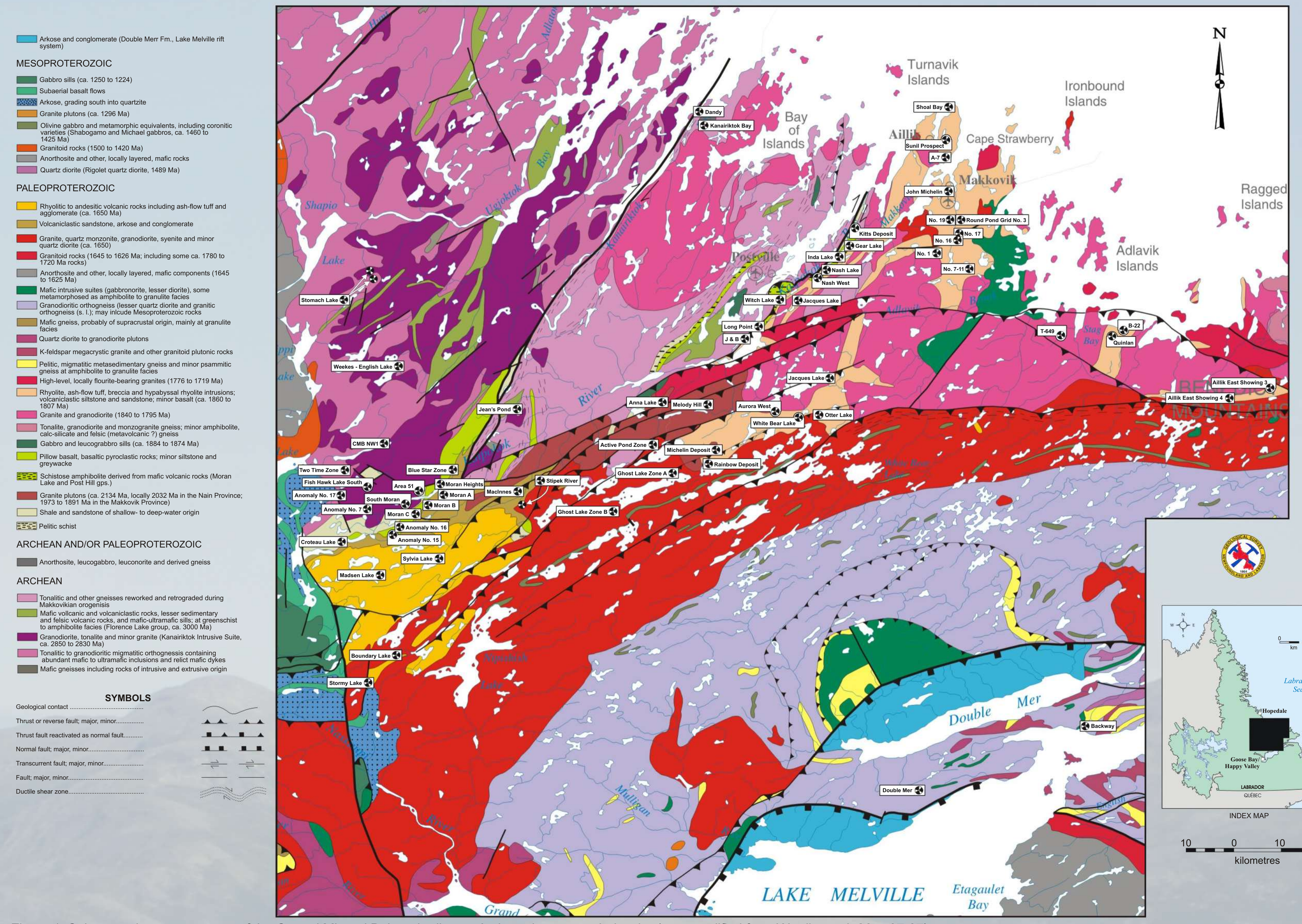

Figure 1: Select uranium occurrences of the Central Mineral Belt and adjacent Archean basement, Labrador (map modified from Wardle *et al.*, Map 97-07)

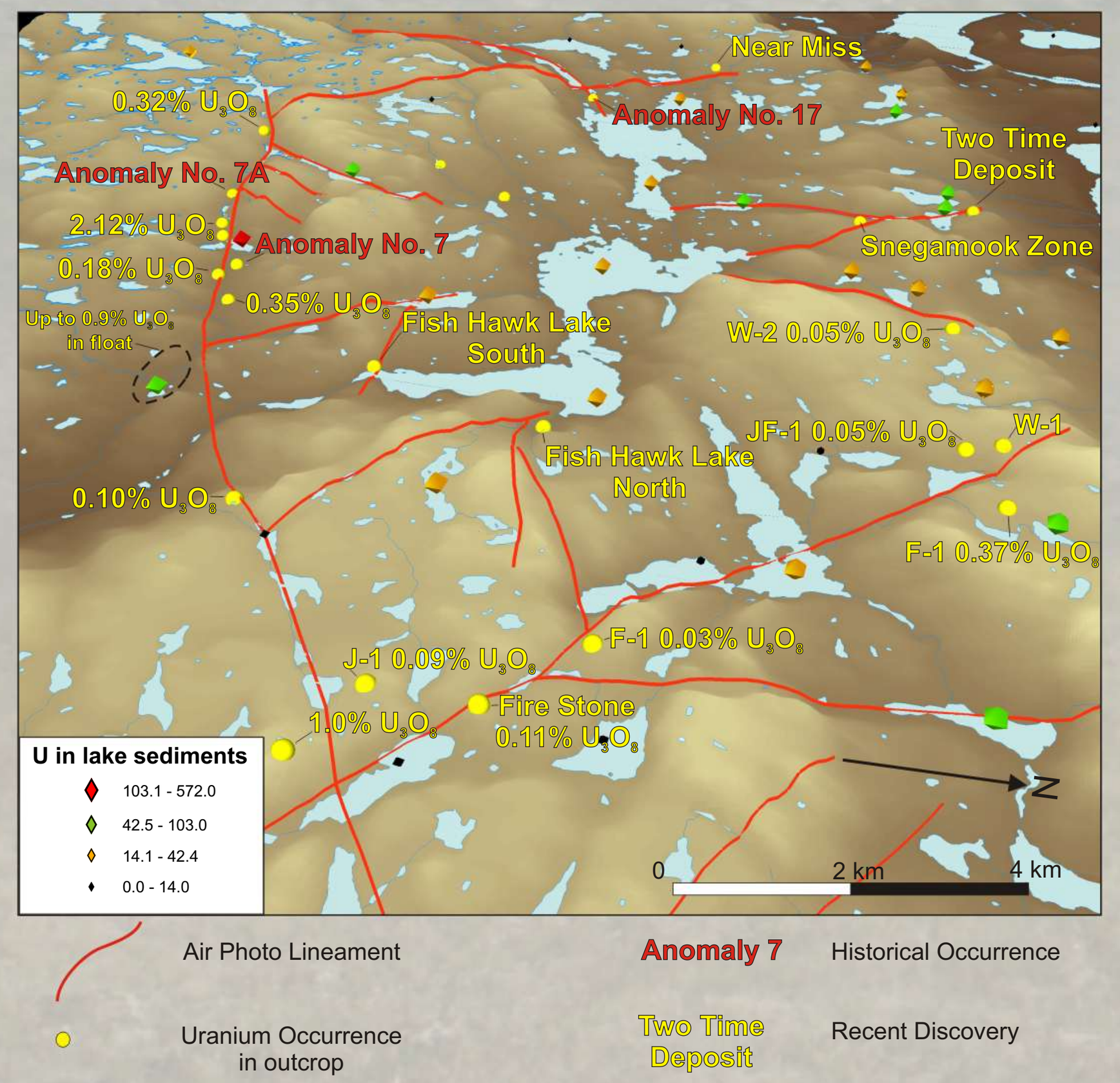

Figure 2: Distribution of historical and recently discovered uranium occurrences in Archean basement rocks in the western CMB. Information compiled from Santoy Resources and Silver Spruce Resources websites.

Plate 1: Uraniferous pegmatite displaying characteristic pale yellow weathering, Dandy prospect.

Plate 2: Uraniferous pegmatite intruding surrounding gneissic rocks, Stomach Lake prospect.

Plate 3: Fracture-hosted hematization associated with uranium mineralization, Anomaly No. 7 prospect.

Epigenetic, Plutonic-Hosted Mineralization

This style of uranium mineralization encompasses some of the highest grade material recorded to date within the CMB, and is found throughout the region, ranging from Archean basement rocks in the west to ca. 1800 Ma intrusions in the Benedict Mountains region to the east. This mineralization style is characterized by an intense hematitic alteration developed within or marginal to mineralized fracture or fault zones. Typical examples include the historical Anomaly No. 7 prospect (Plate 3; Figure 1), which has recorded drill hole intercepts of 0.13% U_3O_8 over 23.4m. Recent exploration in this region has produced numerous new occurrences within the surrounding area (e.g. Fish Hawk Lake South prospect, Plate 4; Figure 1); these occurrences generally display a close spatial association with structural lineaments, as shown in Figure 2, providing supporting evidence for the overall structural control of the mineralization. Elsewhere within the CMB mineralized float from the Melody Hill prospect has returned grades of up to 28.2% U_3O_8. Although a source of the high-grade float has yet to be located, similar mineralization, albeit of lower grade, is locally observed in nearby outcrops (Plate 5; Figure 1). More recently, mineralization of this style has been discovered within what is interpreted to be the ca. 1800 Ma Stag Bay granodiorite in the region of the Benedict Mountains (e.g. T-649 prospect, Plate 6; Figure 1).

Volcanic-Hosted Mineralization Without Widespread Alteration

Volcanic rocks of the Bruce River Group are known to host several examples of this style of mineralization, including the Madsen and Sylvia Lake prospects (Figure 1). This style of mineralization generally has a sporadic distribution within network-style fractures and permeably layers in the host volcanic succession. Uranium mineralization is interpreted to have formed from the remobilization of uranium from the surrounding volcanic rocks and is often accompanied by minor Mo and F (Plate 7). An autoradiograph from a sample assaying 0.7% U_3O_8, shown in Plate 8, displays the sporadic distribution of uranium within the sample. From this image it is evident that the majority of the radioactivity is contained within the crosscutting fractures, representing late remobilization of the uranium.

Volcanic-Hosted Mineralization Associated With Widespread Metasomatism

Extensive zones of mineralization have been identified at both the Michelin and Jacques Lake deposits (Figure 1). In these regions uranium mineralization is hosted within intermediate to felsic metavolcanic rocks of the Aillik Group. The development of a moderate to strong hematitic alteration, with or without a broader envelope of Na-metasomatism, is characteristic of the mineralization and it is generally inferred to have an overriding structural control.

Plate 4: Tonalite displaying variable hematization, Fish Hawk Lake South prospect.

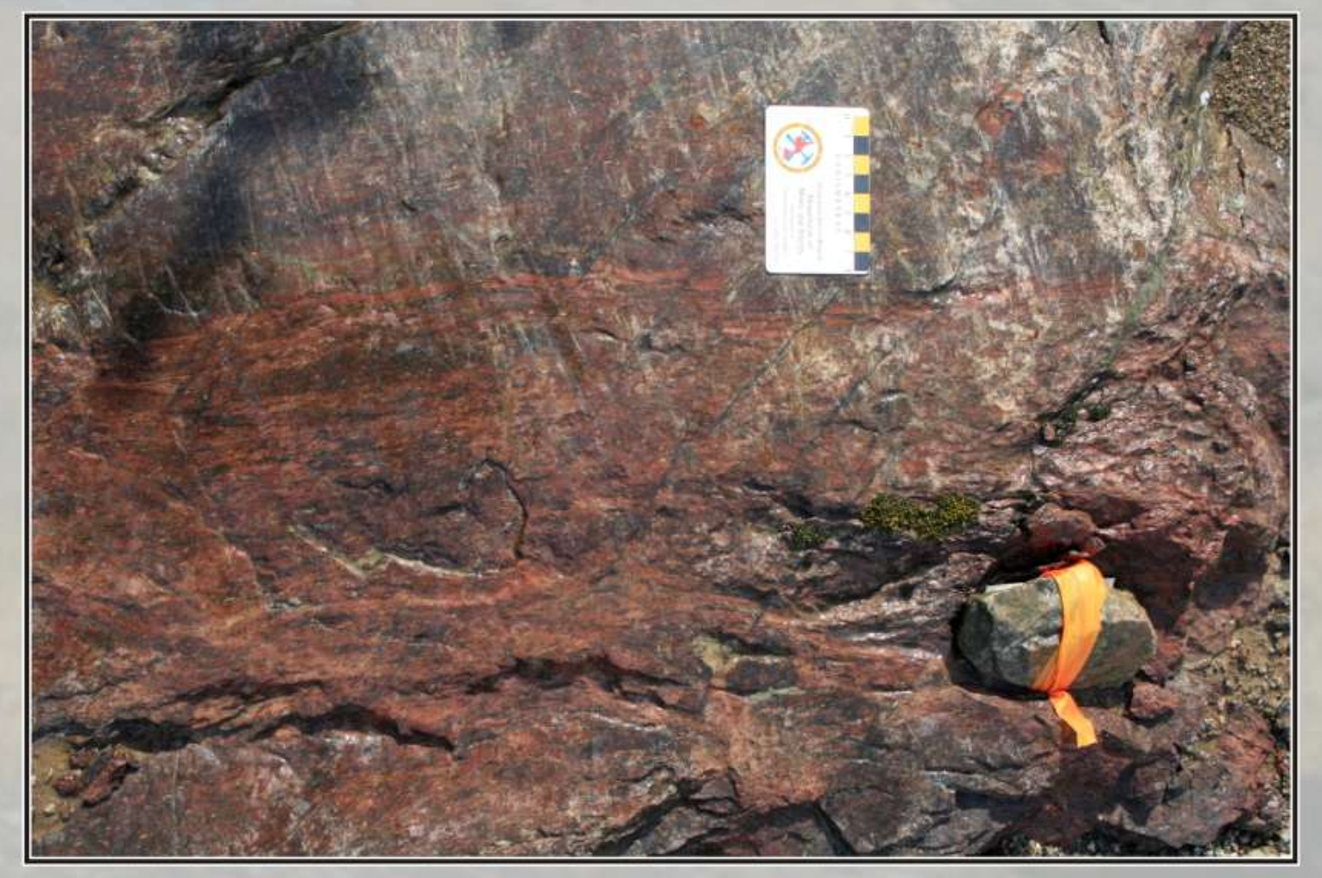

Plate 5: Hematite alteration developed within sheared granite, Melody Hill prospect.

Plate 6: Unaltered fine-grained granodiorite (left) transitioning to pervasively hematized equivalent (right), T-649 prospect.

Volcanic-Hosted Mineralization Associated With Widespread Metasomatism (cont'd)

Within the Michelin deposit, uranium mineralization is hosted within variably porphyritic metavolcanic rocks, which are affected by a pervasive Na-metasomatism (Plate 9). This sodic alteration is locally overprinted by intermittent hematite alteration, which displays a parallelism with the main fabric within the host metavolcanic rocks (Plate 10). Regions of highest radioactivity are generally associated with the most intense hematitic alteration. The Jacques Lake deposit is hosted within similarly deformed metavolcanic rocks; however, in this region mineralization is accompanied by the development of actinolite–biotite–carbonate–magnetite±epidote veining (Plate 11). As with the Michelin deposit, areas of highest radioactivity are associated with intermittent hematization in association with vein development (Plate 12).

Metasedimentary-Hosted, Structurally Controlled Mineralization

The most well known example of this style of mineralization is the high-grade Kitts deposit, which is hosted within the Post Hill Group (Figure 1). At the Kitts deposit, high-grade uranium mineralization is inferred to have a predominant structural control and is hosted within sulphide-bearing graphitic argillite. Evans (1980) reported a very restricted geochemical signature of Na-metasomatism developed marginal to the main mineralization, however, no visible evidence of this alteration is observed within drill core and wall-rock alteration is minimal (Plate 13). Recent drilling in the Anna Lake region has indicated further mineralization within pelitic rocks of the Post Hill Group, and points to the regional significance of this group for hosting significant uranium mineralization.

In western portions of the CMB recent drilling has intersected structurally controlled mineralization within the Moran Lake Group, which is inferred to be the stratigraphic equivalent to the Post Hill Group (e.g. Armstrong prospect). At the Armstrong prospect, uranium mineralization is again locally hosted within sulphide-bearing argillite, however, in this region mineralization is accompanied by the development of a moderate to strong hematitic and/or iron-carbonate alteration (Plate 14). This discovery represents a relatively new style of uranium mineralization within the Moran Lake Group, which has historically contrasted the Post Hill Group with respect to the styles of uranium mineralization present within each.

Sedimentary-Hosted Mineralization

Uranium mineralization of this style is predominantly confined to the sedimentary sequences of the Bruce River Group in the western portion of the CMB. In this region significant mineralized intersections have been obtained from areas such as the Moran Lake Lower C Zone deposit and the Moran Heights prospect (Figure 1). Uranium mineralization generally shares a close spatial association with the unconformable contact between the Moran Lake and Bruce River groups. Mineralization is generally hosted within medium- to coarse-grained reduced sandstones and interbedded pebble conglomerate layers in an otherwise oxidized sedimentary sequence (Plate 15). Locally developed mineralization also occurs higher in the stratigraphic sequence where it is associated with the intrusion of mafic dykes (e.g. Moran Lake B Zone); while in other areas uranium mineralization is locally concentrated within pyrite-rich clasts in pebble conglomerate beds (e.g. Moran Lake A Zone).

Hydrothermal Breccia-Hosted Mineralization With Associated Fe-Metasomatism

Uranium mineralization associated with hydrothermal brecciation has been known since the late 1950's in the Moran Lake region. Here pillow basalts of the Moran Lake Group host the development of extensive zones of hydrothermal brecciation in association with iron-metasomatism and iron-carbonate alteration (Plate 16). Uranium mineralization is generally associated with dark purple hematite alteration, but is also locally associated with a more pervasive iron-carbonate alteration developed within structural conduits (Plate 17). Mineralization within the Moran Lake Upper C Zone is also accompanied by anomalous values of V, Cu and Ag; displaying many common characteristics with IOCG styles of mineralization.

More recently, breccia-hosted uranium mineralization has been discovered in Archean basement rocks (e.g. Two Time deposit). In this region brecciated and hematized tonalitic intrusive rocks of the ca. 2800 Ma Kanairiktok Intrusive Suite hosts uranium mineralization (Plate 18). Breccia development within this region has an overall linear trend and is inferred to have an overriding structural control.

ACKNOWLEDGMENTS

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[1] Beavan, A.P., 1958: The Labrador uranium area. Geological Association of Canada Proceedings, Volume 10, pages 137-145.

REFERENCES

Evans, D.
1980: Geology and petrochemistry of the Kitts and Michelin uranium deposits and related prospects, Central Mineral Belt, Labrador. Unpublished Ph. D. thesis, Queen's University, Kingston, Ontario, 311 pages.

Gandhi, S.S.
1978: Geological setting and genetic aspects of uranium occurrences in the Kaipokok Bay Big River area, Labrador. Economic Geology, Volume 73, pages 1492- 1522.

Ketchum, J.W.F., Barr, S.M., Culshaw, N.G., and White, C.E.
2001: U-Pb ages of granitoid rocks in the northwestern Makkovik Provinces, Labrador: evidence for 175 million years of episodic synorogenic and postorogenic plutonism. Canadian Journal of Earth Sciences, vol. 38, pages 359-372.

Ryan, B.
1984: Regional Geology of the Central Part of the Central Mineral Belt, Labrador. Government of Newfoundland and Labrador, Department of Mines and Energy, Mineral Development Division, Memoir 3, 1984, 200 pages.

Sparkes, G.W. and Kerr, A.
2008: Diverse styles of uranium mineralization in the Central Mineral Belt of Labrador: an overview and preliminary discussion. *In* Current Research, Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Report 08-1, pages 193-227.

Wardle, R.J, Gower, C.F., Ryan, B., Nunn, G.A.G., James, D.T. and Kerr, A.
1997: Geological Map of Labrador; 1:1 million scale. Government of Newfoundland & Labrador, Department of Mines and Energy, Geological Survey, Map 97-07.

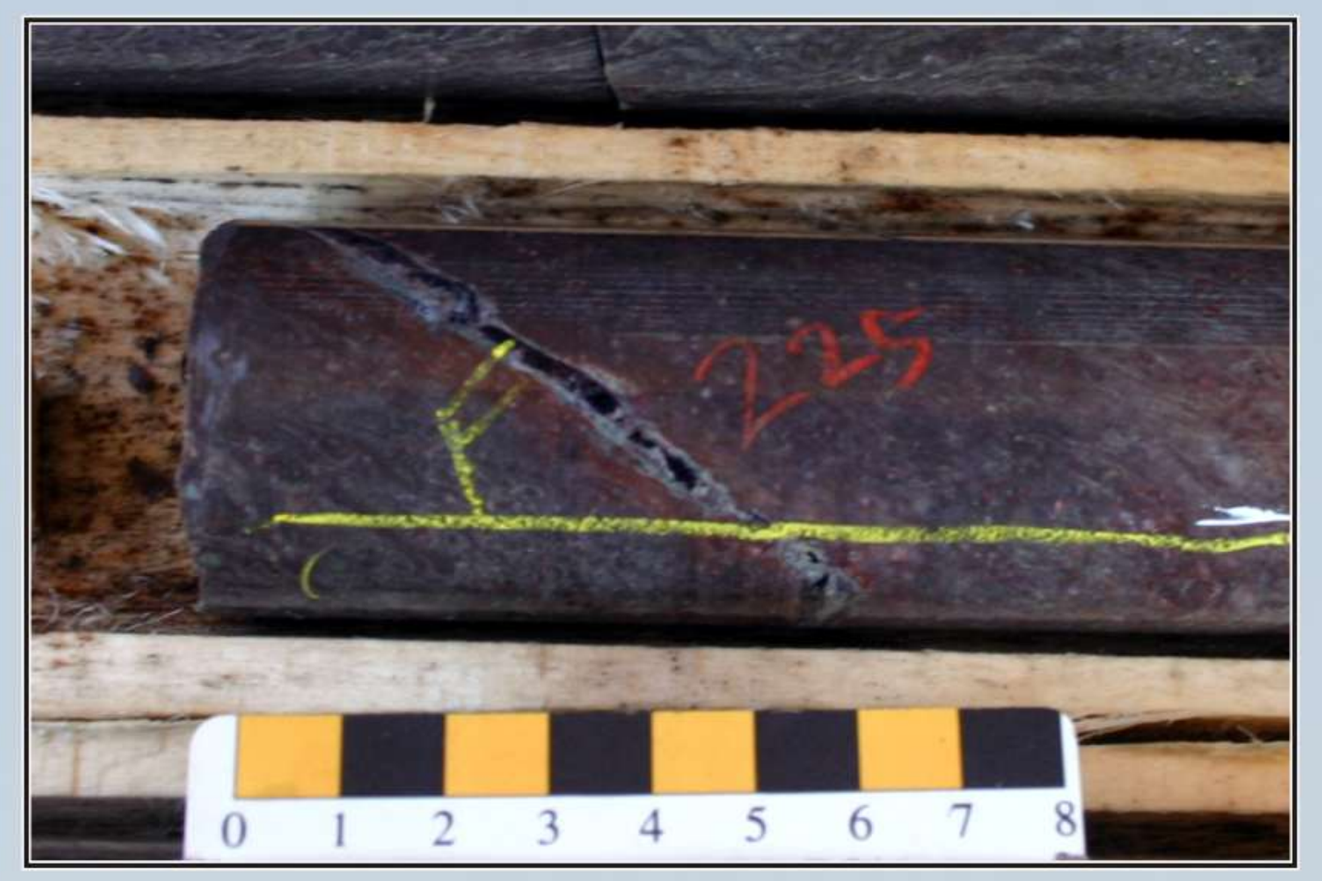

Plate 7: Radioactive fracture hosting dark purple fluorite. Note the hematite alteration developed in the wall-rock, Madsen Lake prospect.

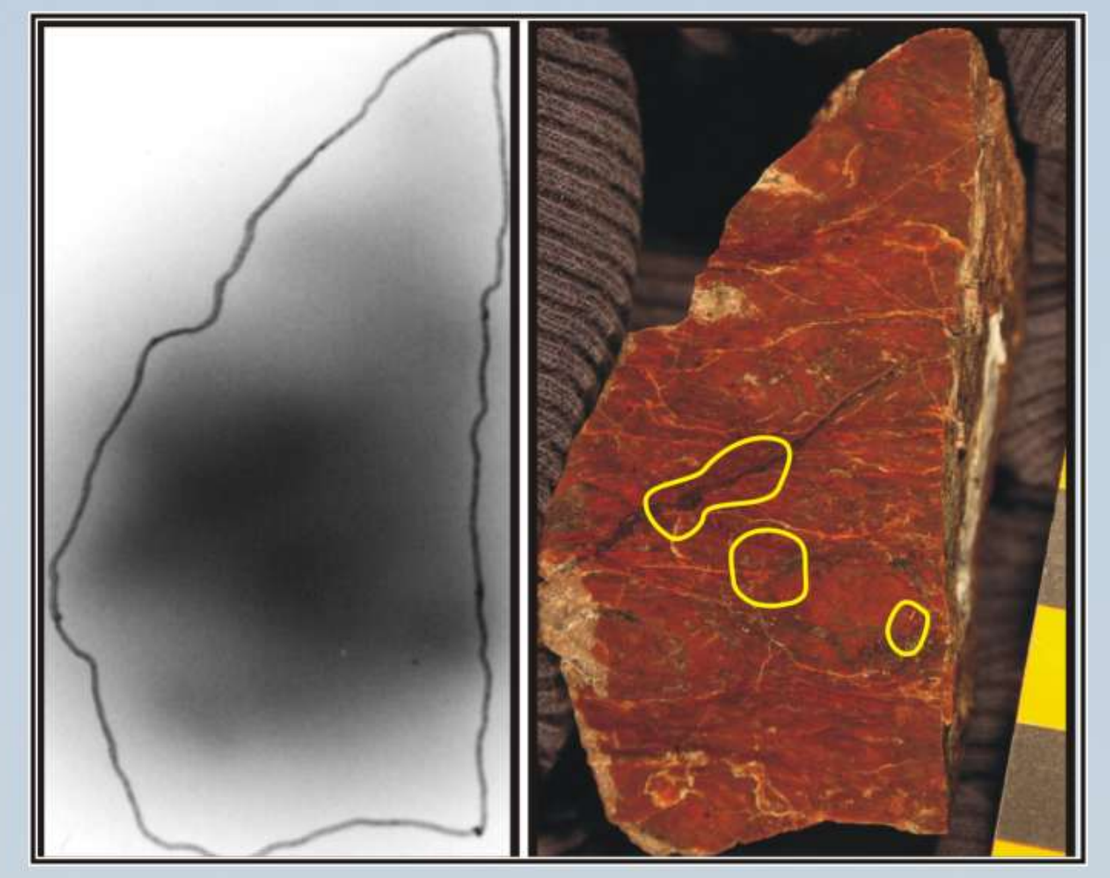

Plate 8: Radioactive hand sample (right) with accompanying autoradiograph (left) showing distribution of radioactivity (darker areas), Sylvia Lake.

Plate 9: Pervasive Na-metasomatism with weakly developed intermittent hematite alteration, Michelin deposit.

Plate 10: Intense hematite alteration in association with elevated radioactivity, Michelin deposit.

Plate 11: Actinolite–biotite–carbonate–magnetite±epidote veining in association with elevated radioactivity, Jacques Lake deposit.

Plate 12: Hematitic alteration in association with strong radioactivity, Jacques Lake deposit.

Plate 13: High-grade uranium mineralization hosted with sulphide-bearing argillite, Kitts deposit.

Plate 14: Pervasive, structurally controlled hematitic alteration, developed with sulfide-bearing argillite, Armstrong prospect .

Plate 15: Reduced sandstone containing pale pink carbonate flooding of the sandstone matrix and minor carbonate veining, Moran Heights prospect.

Plate 16: Well developed hydrothermal breccia containing hematized basalt fragments within a hematite-rich matrix, Moran Lake Upper C Zone deposit.

Plate 17:Pervasive iron-carbonate alteration associated with anomalous radioactivity, Moran Lake Upper C Zone deposit.

Plate 18: Brecciated tonalite hosted within a hematite–chlorite-rich matrix, Two Time deposit.