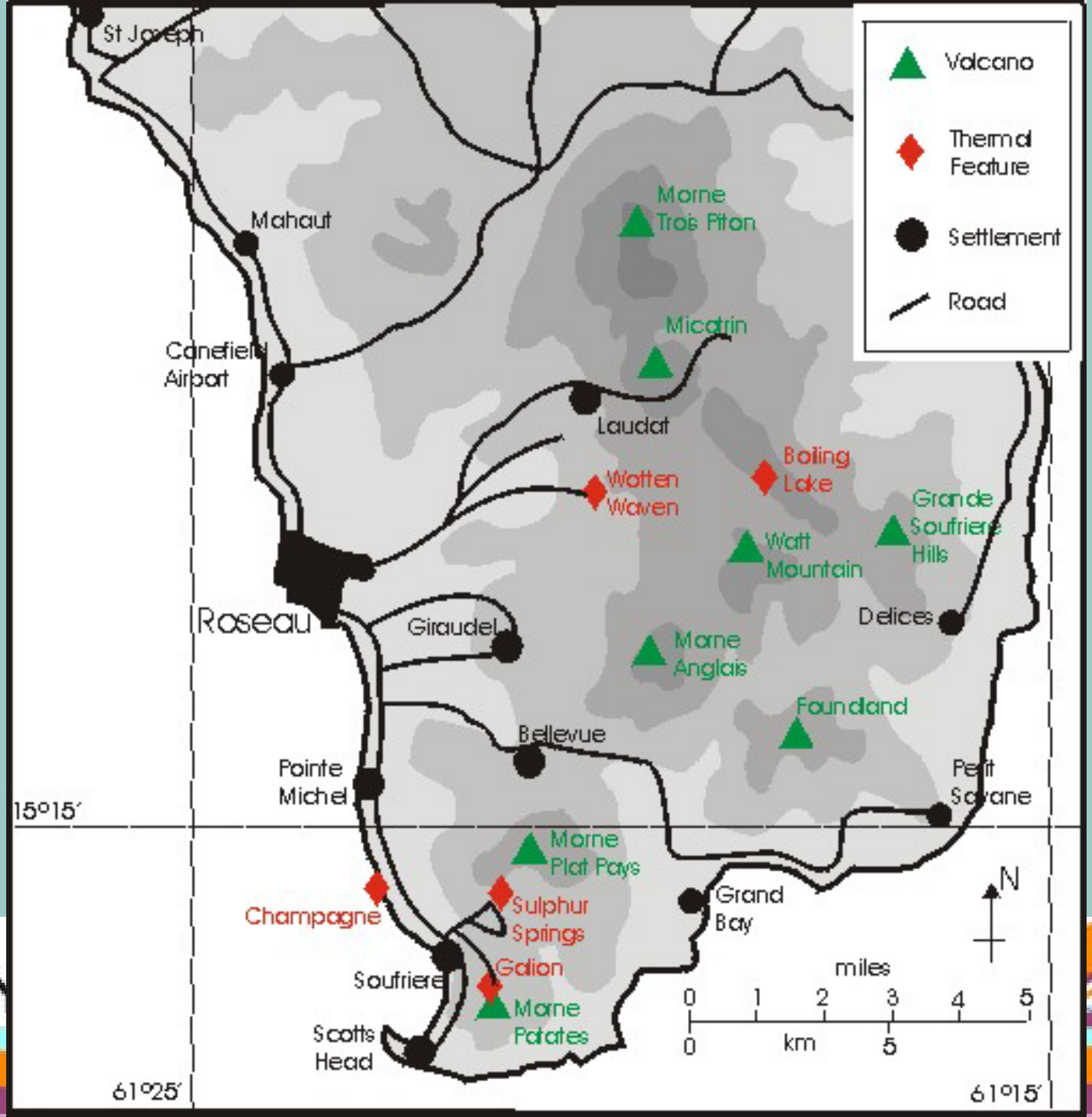
Dominica Geothermal Exploration

Dr Simon Young

Geo-Caraïbes Project

Technical Assistance Team

GeoSY Ltd

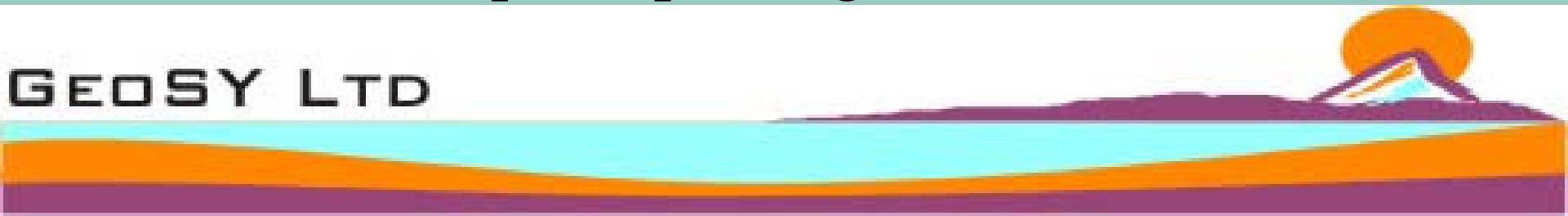

Volcano
Thermal Feature
Settlement
Road
St Joseph
Mahaut
Canefield Airport
Morne Trois Piton
Micotrin
Laudat
Boiling Lake
Watten Waven
Grande Soufriere Hills
Watt Mountain
Delices
Roseau
Giraudel
Morne Anglais
Foundland
Bellevue
Pointe Michel
Petit Savane
15°15′
Morne Plat Pays
Champagne
Sulphur Springs
Grand Bay
Soufriere
Galion
Morne Patates
Scotts Head
N
miles
0 1 2 3 4 5
0 km 5
61°25′
61°15′

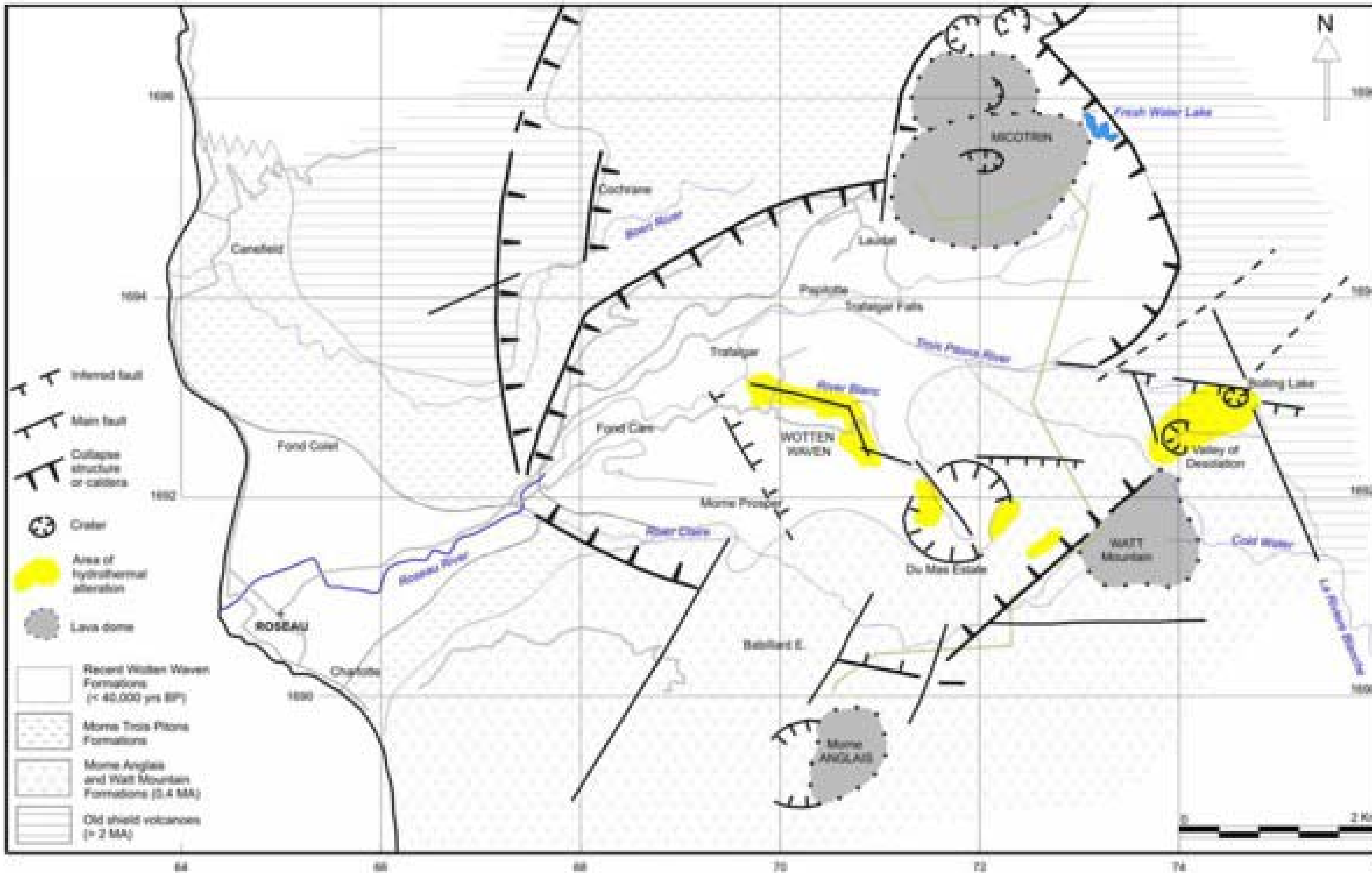
Focus on Wotten Waven

- Work historically undertaken and geothermal potential identified at several sites in southern Dominica; review of data by TAT supported previous focus on best overall development prospect at Wotten Waven
- CFG Services contracted to build upon previous, mainly BRGM, work at Wotten Waven and out to Boiling Lake, with assistance from the project Technical Assistance Team

A Volcanic Landscape

- Wotten Waven is within a large, active volcano-tectonic depression which is surrounded by the volcanic centres of Micotrin, Watt Mountain and Morne Anglais
- The deep volcanic and shallower hydrothermal systems are complex and long-lived
- Previous geophysics has supported surface evidence in defining the River Blanc at Wotten Waven as a principal target




N
Fresh Water Lake
MICOTRIN
Cochrane
Canefield
Laudat
Papillote
Trafalgar Falls
Trafalgar
Trois Pitons River
Boiling Lake
River Blanc
WOTTEN WAVEN
Fond Cani
Fond Colet
Valley of Desolation
Morne Prosper
River Claire
Du Mas Estate
WATT Mountain
Roseau River
ROSEAU
Bellevue E.
Charlotte
Morne ANGLAIS
Inferred fault
Main fault
Collapse structure or caldera
Crater
Area of hydrothermal alteration
Lava dome
Recent Wotten Waven Formations (< 40,000 yrs BP)
Morne Trois Pitons Formations
Morne Anglais and Watt Mountain Formations (0.4 MA)
Old shield volcanoes (> 2 MA)
0
2 Km
64
66
68
70
72
74
76

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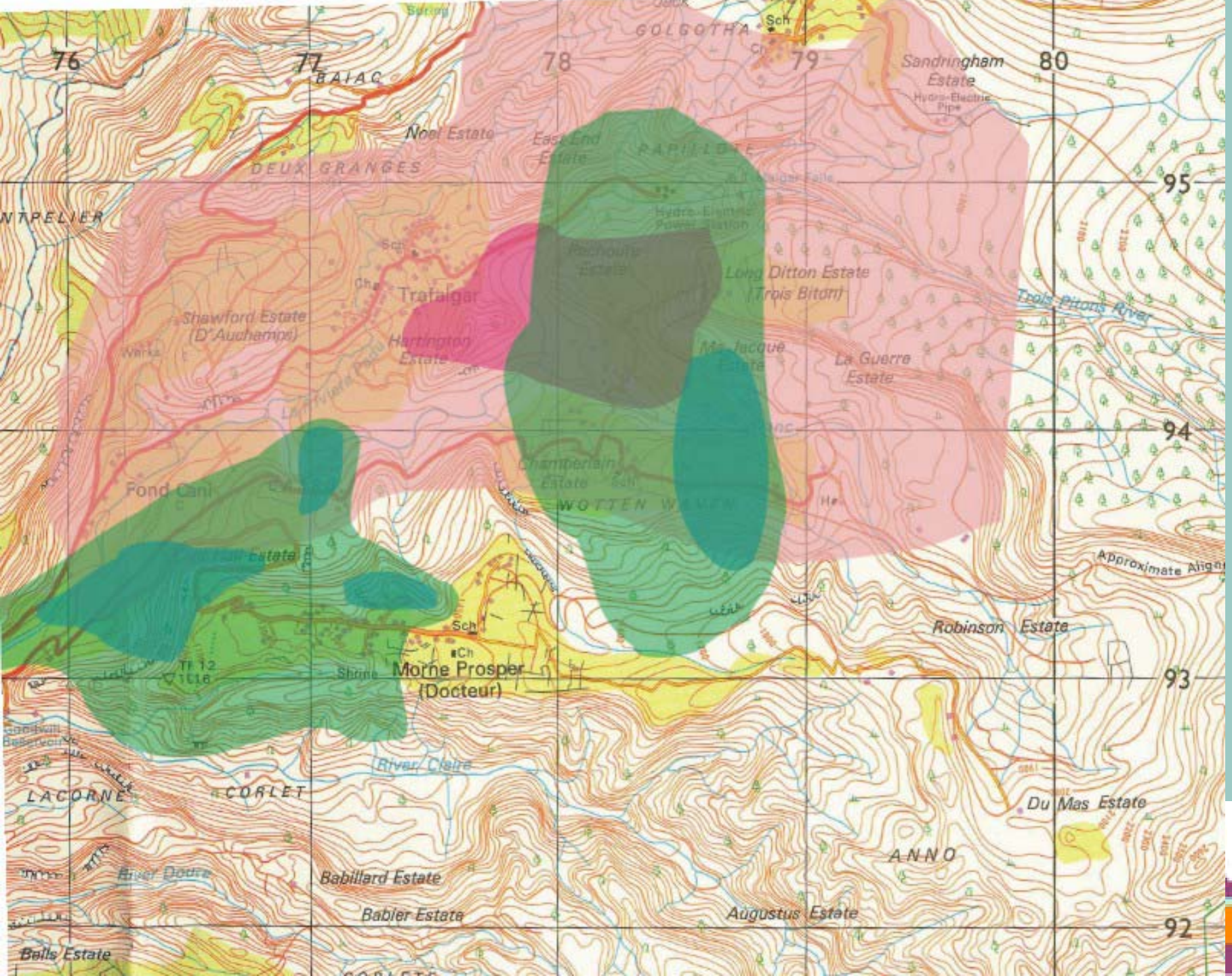
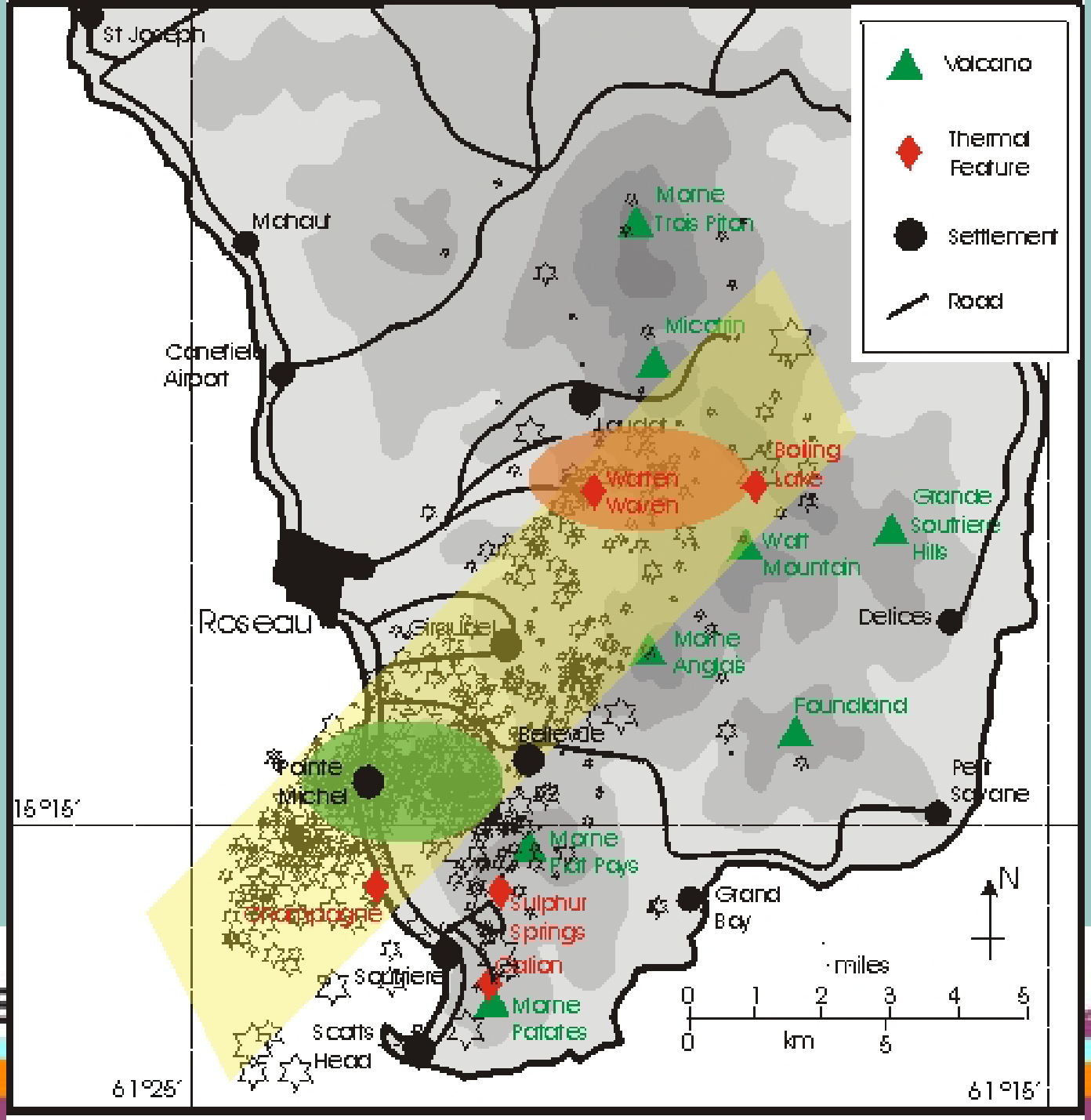

76
77
78
79
80
95
94
93
92
BAIAC
GOLGOTHA
Sandringham Estate
Noel Estate
East End Estate
DEUX GRANGES
PAPILLOTE
Trafalgar
Shawford Estate (D'Auchamps)
Hartington Estate
Pochoute Estate
Long Ditton Estate (Trois Bitons)
Trois Pitons River
La Guerre Estate
Fond Cani
Chamberlain Estate
WOTTEN WAVEN
Morne Prosper (Docteur)
Robinson Estate
Approximate Align
River Claire
LACORNE
CORLET
Du Mas Estate
ANNO
Babillard Estate
Babler Estate
Augustus Estate
River Doux
Balls Estate


St Joseph
Mahaut
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Warren
Grande Soufriere Hills
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Roseau
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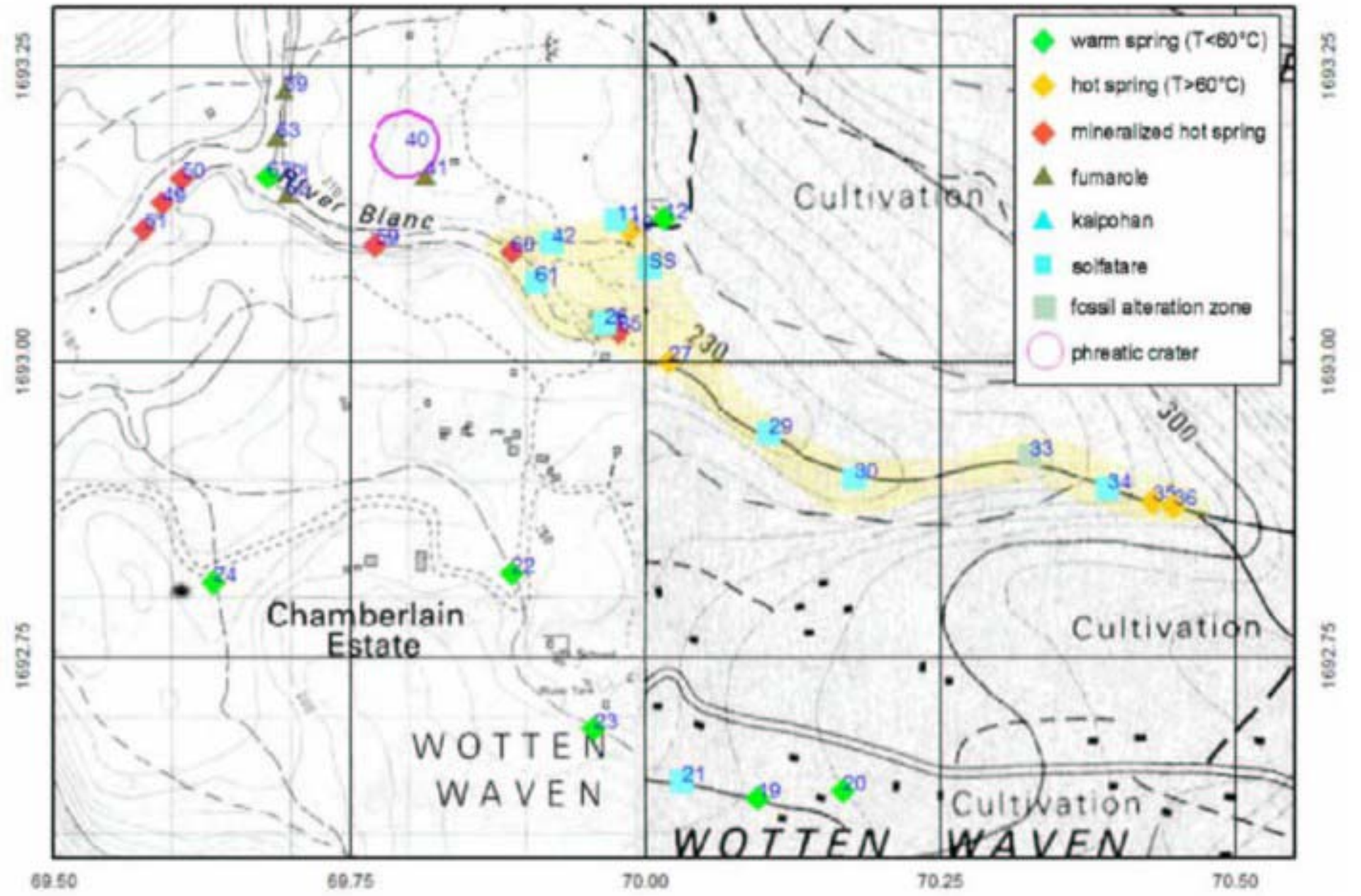
Morne Anglais
Delices
Belfield
Pointe Michel
Foundland
Petit Soufriere
15°15'
Morne Diablotin
Sulphur Springs
Grand Bay
Soufriere
Morne Patates
Scotts Head
61°25'
61°15'
N
miles
0 1 2 3 4 5
0 km 5
Volcano
Thermal Feature
Settlement
Road

New Work

- CFG work concentrated on geochemistry and structural geology
- Geochemistry used to characterise the resource at depth, especially in terms of temperature of resource and hydrothermal regime
- Structural geology important in identifying subsurface porosity/permeability characteristics and ultimately in helping to find the best subsurface flow rates


warm spring (T<60°C)
hot spring (T>60°C)
mineralized hot spring
fumarole
kaipohan
solfatare
fossil alteration zone
phreatic crater
Cultivation
Chamberlain Estate
WOTTEN WAVEN
230
300
1693.25
1693.00
1692.75
69.50
69.75
70.00
70.25
70.50

Findings - Geochem

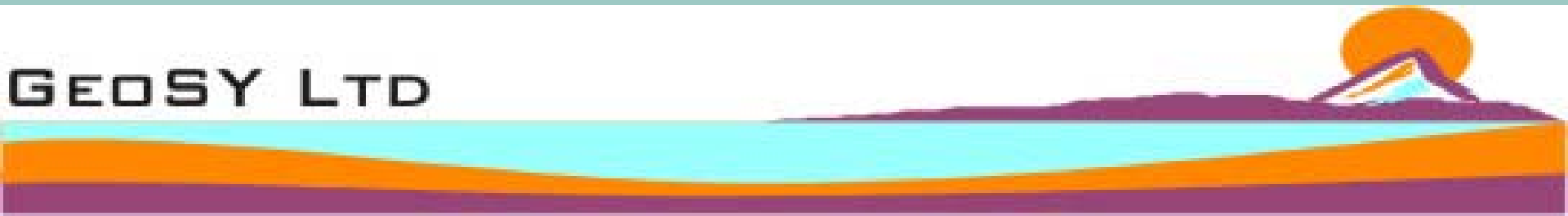
- Geochemistry supports and greatly enhances the existing BRGM work
- Confidence in presence of primary geothermal waters with paleaotemperatures of 210-230 Celsius
- Better understanding of the interaction between primary geothermal fluids and gasses and the overlying shallow aquifers and leakage at warm and hot springs and fumaroles

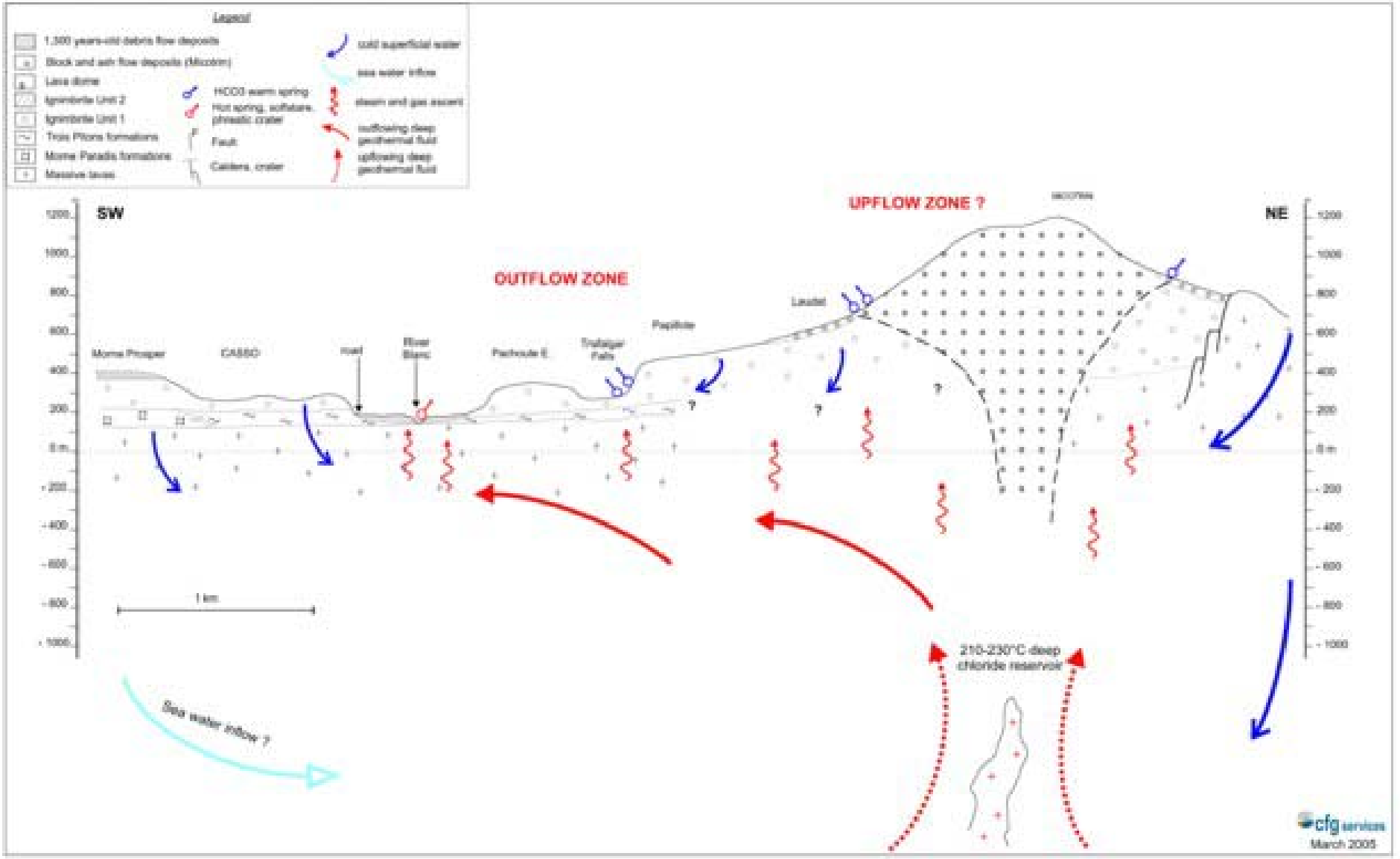
Findings - Structures

- Fracturing is well-developed in older basement lavas as well as in the more recent pyroclastic cover
- Dominant fracture set NE-SW parallels and is likely related to the previously identified fault and seismicity trends
- Other NW-SE to N-S fracture set also present, and the combination provides for good potential for fracture permeability at depth

Geothermal Model

- Preferred model is for a magmatic (5-10 km deep?) heat source beneath Micotrin supporting a hot, extensive hydrothermal system.
- Structural and hydrological conditions allow primary waters to move away and upwards, mainly within the River Blanc valley
- Elsewhere, heat and gas from the hydrothermal reservoir heats perched aquifers to give un-mineralised warm and hot springs




Legend
1,500 years-old debris flow deposits
Block and ash flow deposits (Micotrin)
Lava dome
Ignimbrite Unit 2
Ignimbrite Unit 1
Trois Pitons formations
Morne Paradis formations
Massive lavas
HCO3 warm spring
Hot spring, solfatare, phreatic crater
Fault
Caldera, crater
cold superficial water
sea water inflow
steam and gas ascent
outflowing deep geothermal fluid
upflowing deep geothermal fluid
SW
NE
UPFLOW ZONE ?
OUTFLOW ZONE
Morne Prosper
CASSO
Hotel
River Blanc
Pachoute E
Trafalgar Falls
Papillote
Laudat
1 km
Sea water inflow ?
210-230°C deep chloride reservoir
cfg services
March 2005

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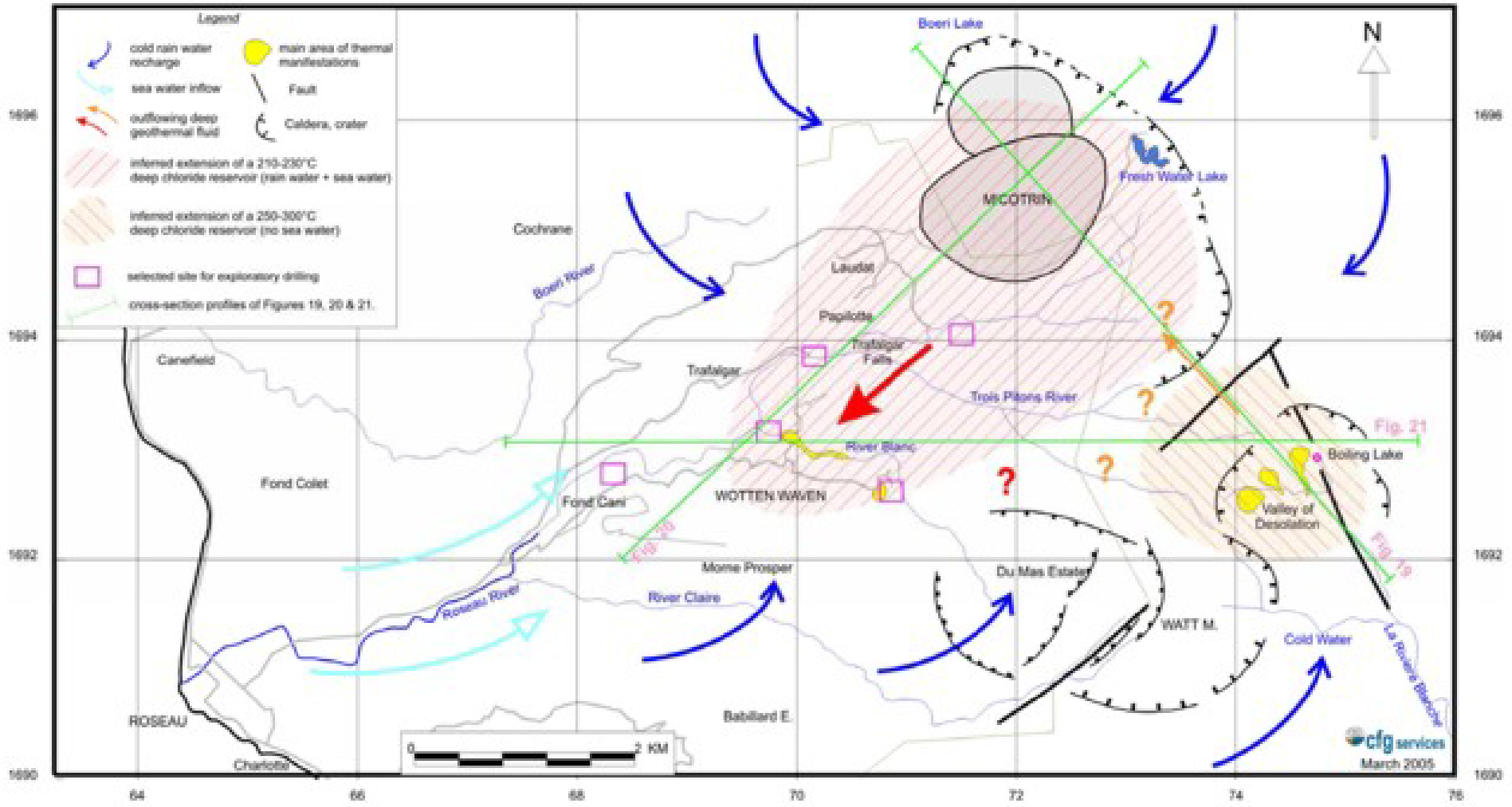
Boiling Lake

- Probably a separate system, maybe quite shallow and small – significant passage of primary hot fluids to the surface over limited area
- Quite young radiocarbon ages (~1,000 yrs) in VoD and DuMas Estate suggest minor magmatic and mainly phreatic activity and support shallow magma body(ies)
- Remoteness precludes geothermal development


Legend
cold rain water recharge
sea water inflow
outflowing deep geothermal fluid
main area of thermal manifestations
Fault
Caldera, crater
inferred extension of a 210-230°C deep chloride reservoir (rain water + sea water)
inferred extension of a 250-300°C deep chloride reservoir (no sea water)
selected site for exploratory drilling
cross-section profiles of Figures 19, 20 & 21.
N
Boeri Lake
Fresh Water Lake
MICOTRIN
Cochrane
Boeri River
Laudat
Papillote
Trafalgar Falls
Trafalgar
Trois Pitons River
Carnefield
Fond Colet
Fond Cani
WOTTEN WAVEN
River Blanc
Fig. 21
Boiling Lake
Valley of Desolation
Fig. 19
Fig. 20
Morne Prosper
River Claire
Roseau River
Du Mas Estate
WATT M.
Cold Water
La Riviere Blanche
ROSEAU
Babillard E.
Charlotte
0
2 KM
cfg services
March 2005
1696
1694
1692
1690
64
66
68
70
72
74
76

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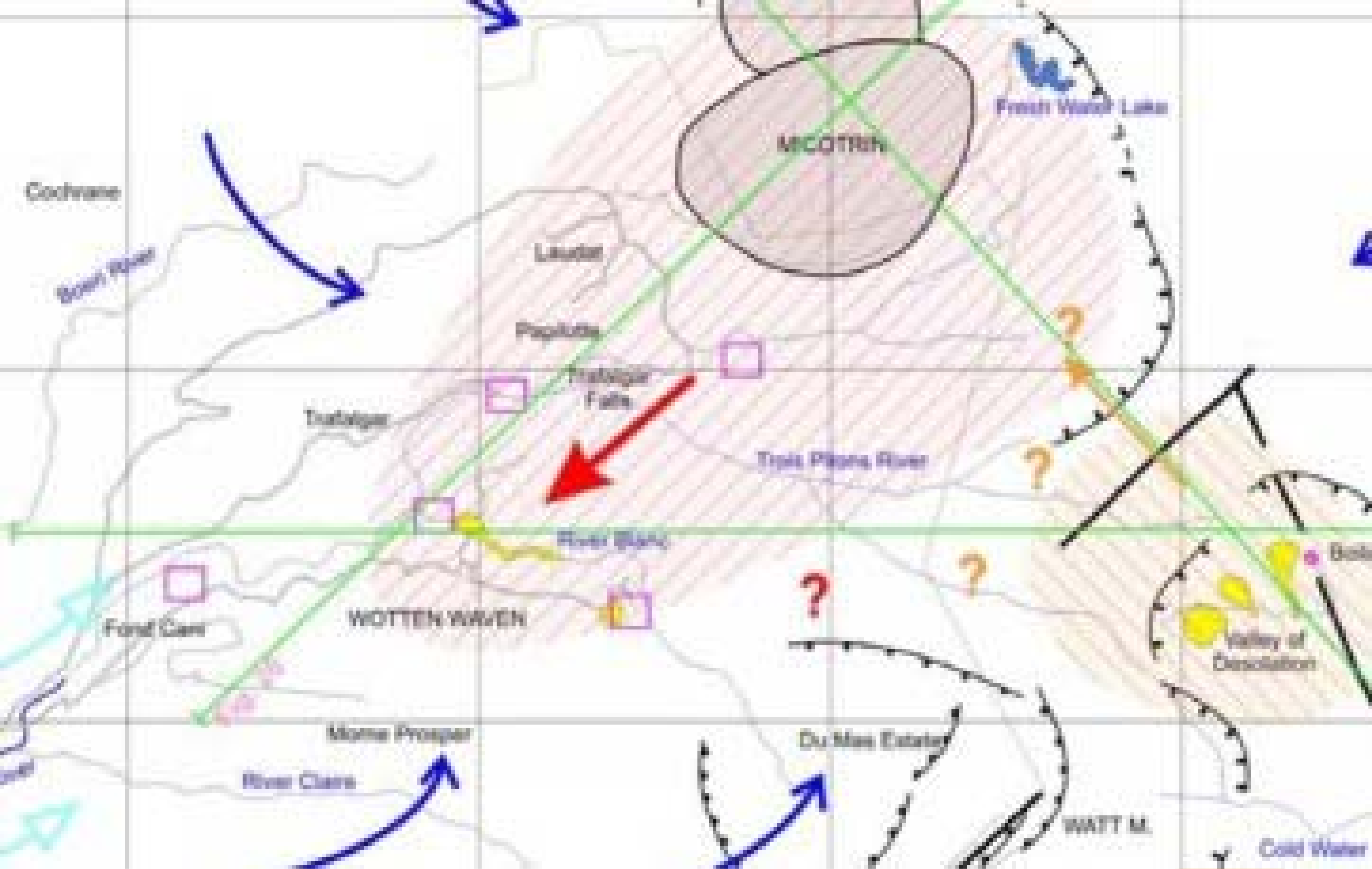
Development Potential

- So far, so good
- BRGM data was sound and has been expanded upon
- Even if the precise geothermal model is not agreed, Wotten Waven is a good prospect
- We have hot water over a large area which has basement fracture permeability

Next Steps

- A little more geochem/geology, especially east of Wotten Waven, to explore extent of Micotrin hydrothermal system
- Wide-area geophysics, probably deep-looking resistivity, to prove and map the Micotrin hydrothermal system outflow zone
- Focused geophysics around proposed drill sites to assist in site selection
- Drilling – 4 principal sites identified, but subject to modification. Prefer deep slim hole exploration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River Blanc
WOTTEN WAVEN
Fond Cani
Morne Prosper
River Claire
Du Mas Estate
Valley of Desolation
WATT M.
Cold Water

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