Fogo Island 2017

Fogo Island Geologist-in-Residence, August to September 2017, Jack Botsford

Overview

Under the auspices of the Geology at the Edge (GATE) program, I acted as the geologist-in-residence on Fogo Island from Aug 18 to September 16, 2017.

A) Guided hikes and community activities

A total of 62 people participated in 11 guided hikes during the course of my stay on Fogo Island.

I also helped facilitate a geology evening at the Library that was organized by Sarah Greene and Sarah Heath (the librarian). Approximately 25 people, predominantly families, participated.

Sarah and I also ran a family geology hike and picnic along the Joe Batts Arm trail, as far as Black Duck Pond. This was popular with younger children.

Toward the end of my stay, I did four forty minute classroom presentations at the school, for grades K, 1, 2 and 6.

Sarah and I also hosted several parties of casual, drop-in visitors at the Geology Centre.

B) Little Fogo Islands

I had the opportunity to visit Little Fogo Islands 3 times during my stay, and noted several volcanic rock types, including varieties of agglomerates, breccias, and sedimentary red beds. It would be an interesting project to map the distribution of these units and provide a generalized summary for visitors. A pictorial comparison with a modern volcanic setting, such as the island of Santorini, in the Aegean, might be worthwhile.

C) Geology of Change Islands – South End

1) Summary

Geological units in the southern half of Change Islands are of interest because they have been correlated with formations mapped on Fogo Island (Currie, 1997). Currie correlated the volcanics in the southernmost with the Brimstone Head Formation but they are very dissimilar to the Brimstone Head in its type locality. Based upon a reconnaissance traverse in 2015, I felt that the southernmost volcanics might, in fact, be assigned to the Lawrenceton Formation, in depostional contact northward with the overlying Fogo Harbour Formation, and exposed in the core of anticline as mapped by Currie (1997).

Based upon further examination this year (2017) I am prepared to accept Currie's interpretation, and see the contact as a southward-younging transitional contact from the Fogo Harbour Formation sedimentary sequence into tuffs and then volcanics of the Brimstone Head Formation. Evidence is discussed below.

2) Background/previous work/hypothesis

As mapped by Currie (1997) the sedimentary sequence, comprising shale, siltstone and sandstone, is assigned to the Fogo Harbour Formation (FHF). This correlation is accepted (Botsford, 2015). Change Island rocks appear to be a more distal equivalent of the FHF on Fogo Island. Currie assigns the tuffs and volcanic rocks at the southern end of the island to the Brimstone Head Formation.

A traverse along the western shore through the sedimentary sequence in 2015 was conducted. Several north-younging orientations were noted within laminated sandstone beds. An apparently transitional boundary southward, through siltstone, shale, into tuffs and then to volcanic rocks was also noted. These volcanic rocks are generally green or reddish rhyolites, commonly phenocrystic and frequently demonstrating a brecciated texture. They are interbedded with tuffs containing angular fragments of rhyolite and coated clasts. To me, these volcanics appear very similar to the Lawrenceton Formation as observed elsewhere on Change Islands and on Indian Islands (Botsford, 2016). They are also completely dissimilar to the black volcanic ignimbrites of the Brimstone Head Formation on Fogo Island.

These observations, combined with the paucity of younging indicators within several hundred meters of the contact, suggested that the volcanics might be

Lawrenceton Formation and that the section is a conformable, north-younging contact between Lawrenceton and Fogo Harbour Formation, terminated farther north by a faulted contact with Lawrenceton again.

3) Follow-up and re-examination

Western Coastline

Variable orientation of sandstone beds does confirm (postdepostional) folding, as indicated by Currie. The section from Muddy Cove southward (Fig 1) begins in laminated, cross-laminated and locally trough cross-laminated, fine to medium sandstone beds, commonly subhorizontal and upright. (North of this point these beds are north-younging). Southward these are transitional into thinly laminated siltstone and then a sequence of soft-sediment-deformed siltstone and shale demonstrating folding and numerous water escape features. This is transitional into shale with rimmed, coated clasts (Photo 1) scattered throughout - essentially a diamictite, or matrix-supported conglomerate. Southward the coated clasts continue, but the matrix changes progressively southward into tuff, becoming bedded tuff with coated clasts, then angular fragments of rhyolite, then volcanics. No younging indicators were found within several hundred meters of the volcanic contact.

Eastern Coastline

The eastern coastline was accessed by walking across the island, to Glory Cove, and then traversed southward. Unfortunately a steep coastal cliff immediately north of Snows Harbour precluded examination of the contact with the volcanics on this traverse.

The sedimentary section is very similar to the western coast, beginning at Glory Cove in laminated and locally cross-laminated fine sandstone, commonly subhorizontal and upright, (Photo 2) but with variable attitudes reflecting (post-depositional) folding. This is transitional southward into soft-sediment deformed siltstone and shale, and then diamictite with coated clasts (Photo 2). The impassable section is south of Snows Head and at this point the matrix is partially tuffaceous. (Photo 3). Promontories within Snows Harbour, observed with binoculars, are clearly volcanic and some gossan appears to be present.

Snows Harbour was subsequently visited by Dave McConkey, who has provided photos of a very sharp contact between volcanics and what appears to be tuffaceous sedimentary rock.

<u>Photo 1</u>: Coated clasts within siltstone, Fogo Harbour Formation, Change Islands, southwest coastal section

Photo 2: Subhorizontal planar cross-laminated fine sandstone, Fogo Harbour Formation, Change Islands, southeastern coastal section

Photo 3: Cleaved tuffaceous siltstone, Fogo Harbour Formation, Change Islands, southeastern coastal section

4) Interpretation and discussion

Several factors bear on the interpretation of these observations:

a) No younging indicators were observed within several hundred meters of the sedimentary sequence (FHF) and tuff/volcanic contact.

b) Folding complicates interpretation of the stratigraphic sequence

c) *Dissimilarity with Lawrenceton contact as described and illustrated by Flint and Soderman:*

The contact between the Lawrenceton Formation and overlying Fogo Harbour Formation has been clearly identified and documented by Flint (2016) and Soderman (2016) in exposures at Deep Cove and Outer Island.

These authors illustrate an erosional contact, with clasts of volcanic rock (Lawrenceton) within a basal conglomerate of the Fogo Harbour Formation. This is completely dissimilar to the transitional contact under discussion here.

d) Similarity in upward stratigraphic transition noted on Fogo Island

In sections measured in the vicinity of Simms Beach, Seal Cove and Durham Hill on Fogo Island (Botsford, 2015, 2016) the Fogo Harbour Formation demonstrates a stratigraphic progression upward from massive to bedded sandstone, siltstone and shale to a roughly 50 meter zone dominated by beds of matrix-supported conglomerate with distinctive coated clasts, into a soft-sediment deformed zone with numerous water escape features and a matrix-rich diamictite. The coated clasts are believed to derive from a (depositional) coating of volcanic ash. This is overlain by a sharp contact with volcanic rocks of the Brimstone Head Formation. This bears a strong similarity to the southward progression described from Change Islands. (see Figure 1)

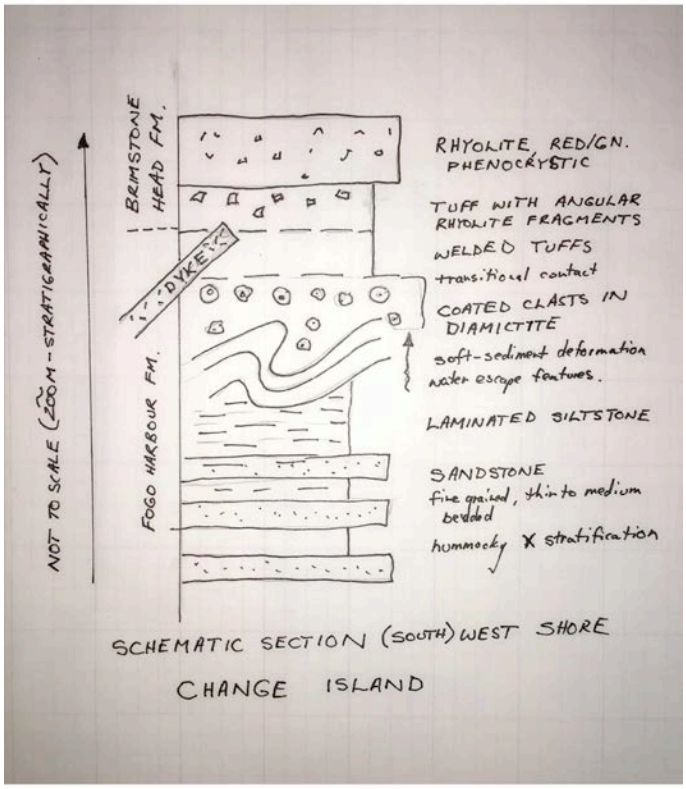

Figure 1 – Schematic section, (south) west shore, Change Island

e) Variability of Brimstone Head Formation

The ***Brimstone Head Formation*** at Brimstone Head and elsewhere on northwestern Fogo Island comprises several hundred meters of black volcanic ignimbrite demonstrating *fiamme* structures. A ?basal rhyolite? with a strange brecciated fabric is locally present.

Elsewhere, on Little Fogo Islands, Currie has included within the ***Brimstone Head Formation***, volcanic rocks of a completely different nature that include thick - bedded volcanic agglomerates, layered flow sequences of phenocrystic rhyolite and redbeds.

If the ***Brimstone Head Formation***, does, in fact represent this variability in volcanic depositional terrains, then it is not unreasonable, on this basis, to include the rhyolites and tuffs of southern Change Islands within this formation.

Based upon this evidence the interpretation reflected in Currie's map provides the best fit at present. A visit to Snows Harbour should be very informative.

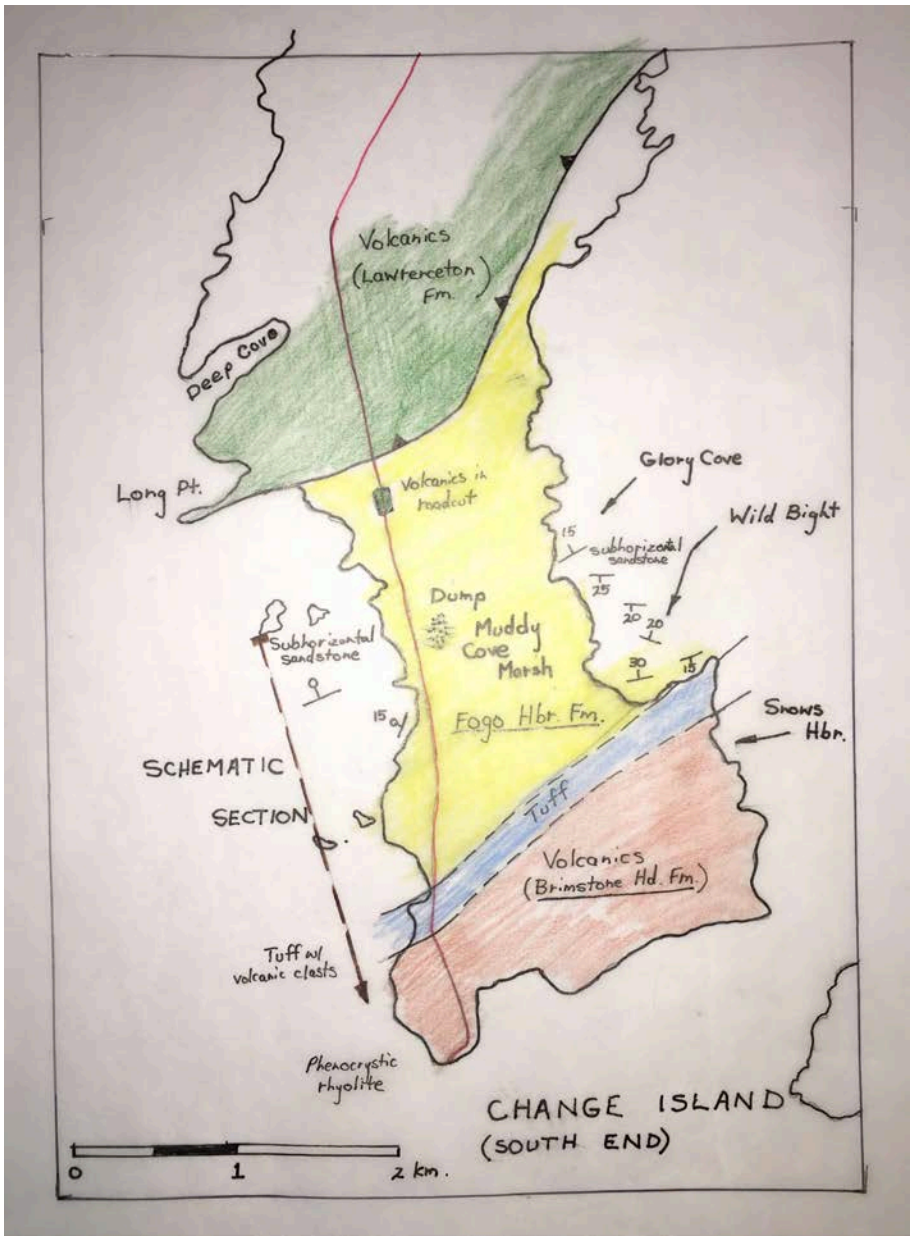

Figure 2 – Summary map – Southern portion of Change Island
(Based upon mapping in 2015 and 2017)

Acknowledgements

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List of References

Baird, D.M.
1958: Fogo Island map-area, Newfoundland. Geological Survey of Canada, Memoir 301.

Botsford, J.W.
2015: The Fogo Harbour Formation: Stratigraphy and Sedimentology, Summary of field work on Fogo Island, 2015. Internal Report - Geology at the Edge Program, Shorefast Foundation, Fogo Island, 46 pp.

Botsford, J.W.
2016: Fogo Island Activities. Internal Report - Geology at the Edge Program, Shorefast Foundation, Fogo Island, 20 pp.

Currie, K.L.
1997a: Fogo map-area, Newfoundland. Geological Survey of Canada, Open File 3466, 1:50,000 scale map with marginal notes.

1997b: A note on the geology of Change Islands, Newfoundland. In Current Research, Part D. Geological Survey of Canada, Report 97-1D, pages 51-57.

Flint, Rachel.
2017: Geological Mapping of Change Islands, thesis – University of Cambridge, 58 pages

Kerr, Andy.
2011: Fogo Island: Exploring a composite bimodal magma chamber and its volcanic superstructure. Geological Association of Canada (Newfoundland and Labrador Section), Fall Field Trip for 2011, 52 pages.

Soderman, Caroline.
2017: Geological Mapping of Change Islands, thesis – University of Cambridge, 42 pages