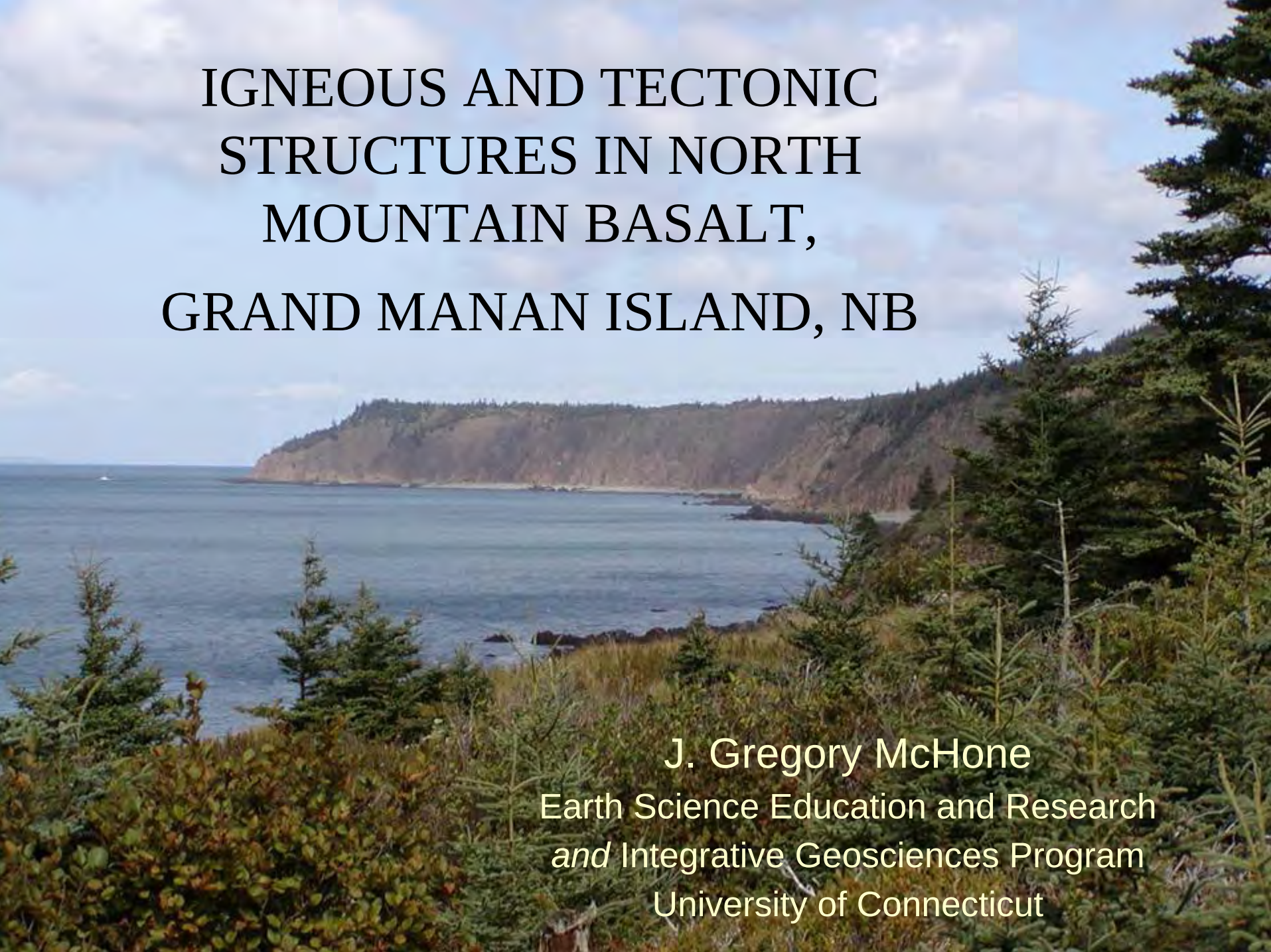


IGNEOUS AND TECTONIC STRUCTURES IN NORTH MOUNTAIN BASALT,

GRAND MANAN ISLAND, NB

J. Gregory McHone
Earth Science Education and Research
and Integrative Geosciences Program
University of Connecticut

The World's Largest Lava Flow

The Early Jurassic (201 Ma) North Mountain Basalt (NMB) of the Fundy Basin has a present area of about 16,500 km^2 and thickness of 200 to 1,000 m. An average of 400 m thickness indicates at least 6,600 km^3 in volume.

This is the largest known lava eruption.

The NMB is truncated at its borders by faults and erosion, thus it was originally larger.

The basalt is thickest in the central, deeper part of the Fundy basin, indicating a giant ponded flow or lava lake.

The NMB appears to be erupted from fissures above large dikes in southern New Brunswick and coastal Maine.

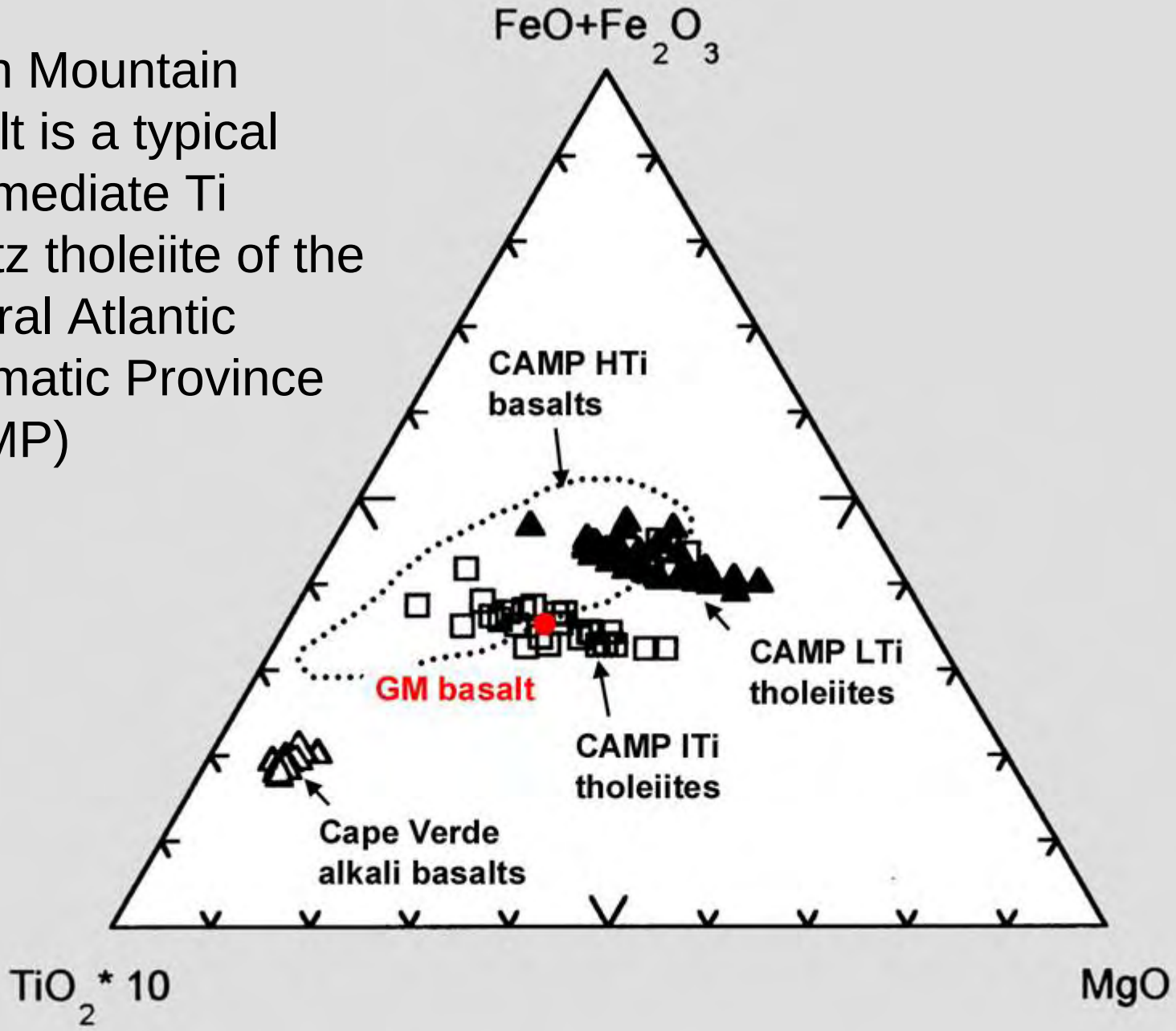
Features Unlike Other Lava Flows

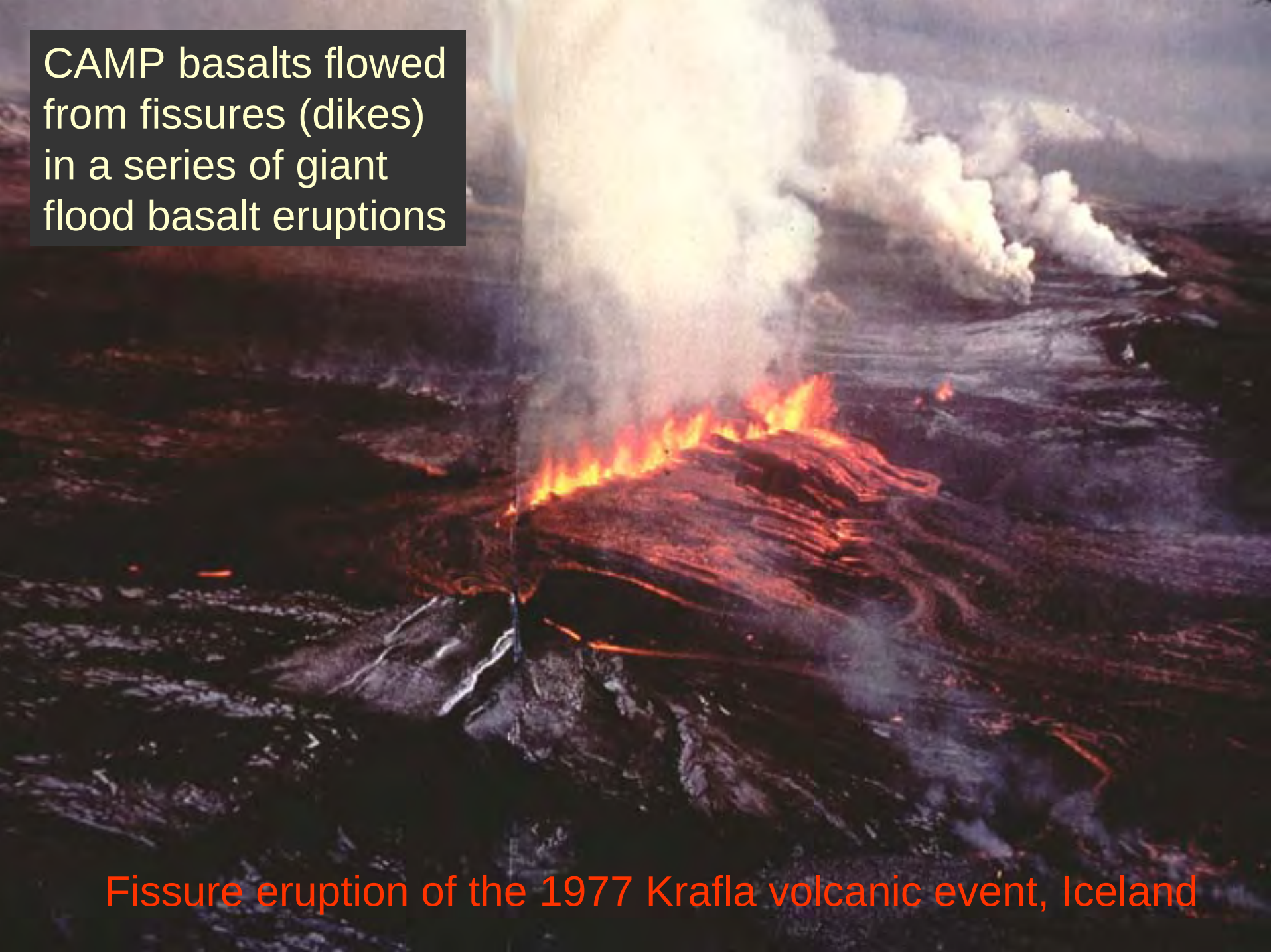
The NMB was constructed with 3 members that are very similar in both Grand Manan (SW basin) and western Nova Scotia (eastern basin).

The three members are distinct, yet are:

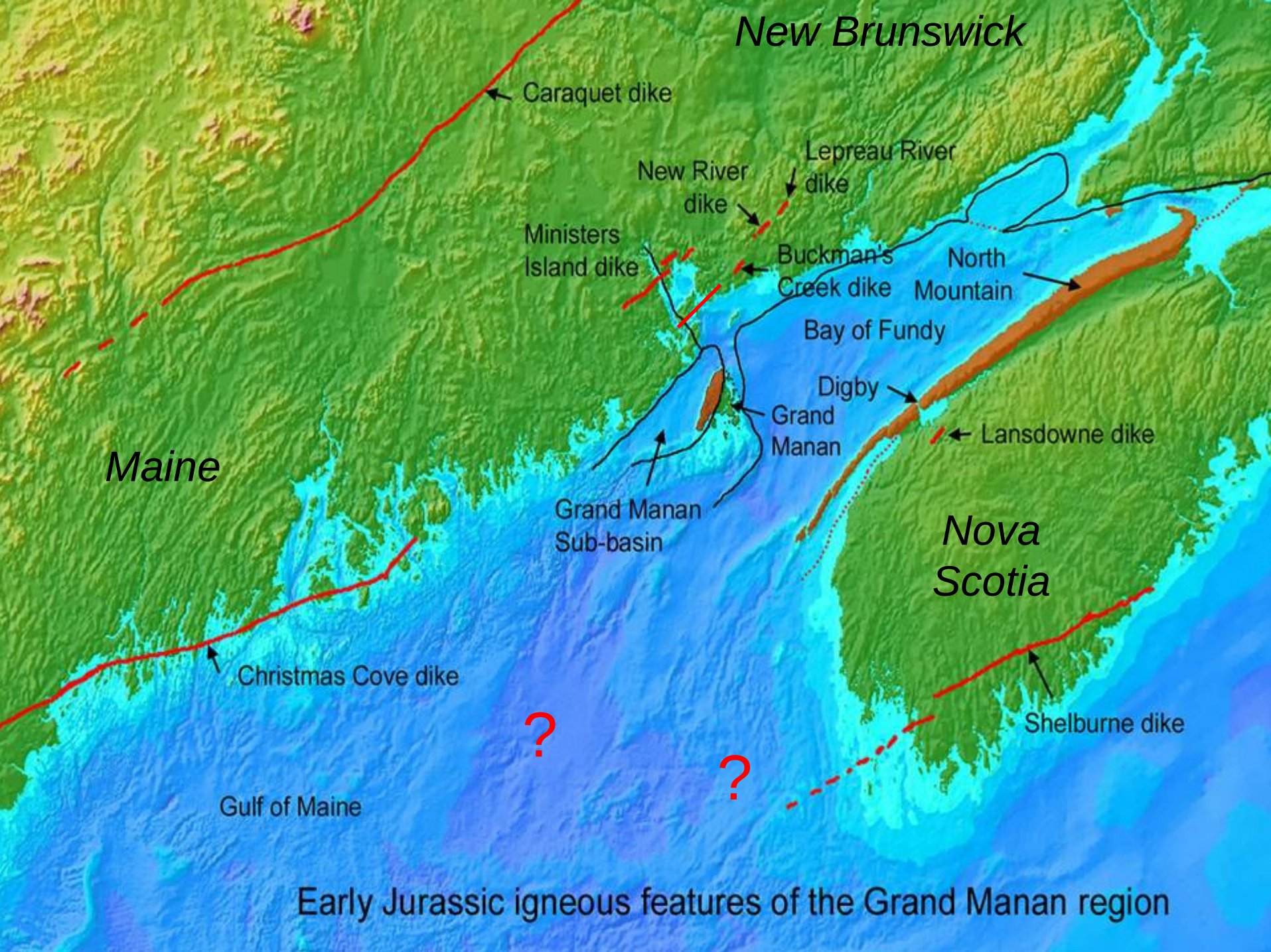
- many separate lava flows of basalt,
- essentially co-magmatic,
- part of the same volcanic event,
- built from the same inflating lava lake,
- cut by faults during and after the magmatism.

North Mountain basalt is a typical intermediate Ti quartz tholeiite of the Central Atlantic Magmatic Province (CAMP)

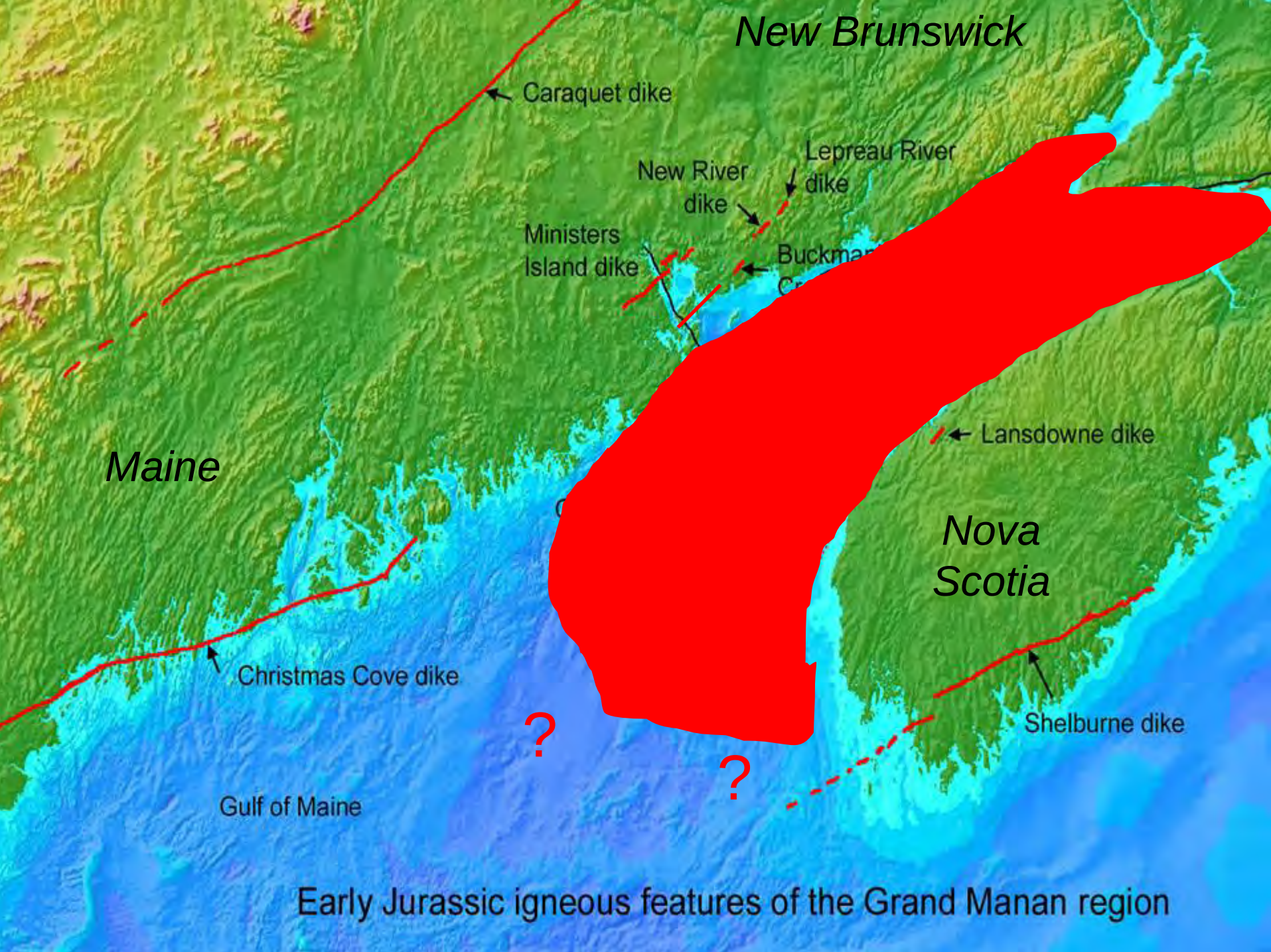




Fissure eruption of the 1977 Krafla volcanic event, Iceland



Early Jurassic igneous features of the Grand Manan region

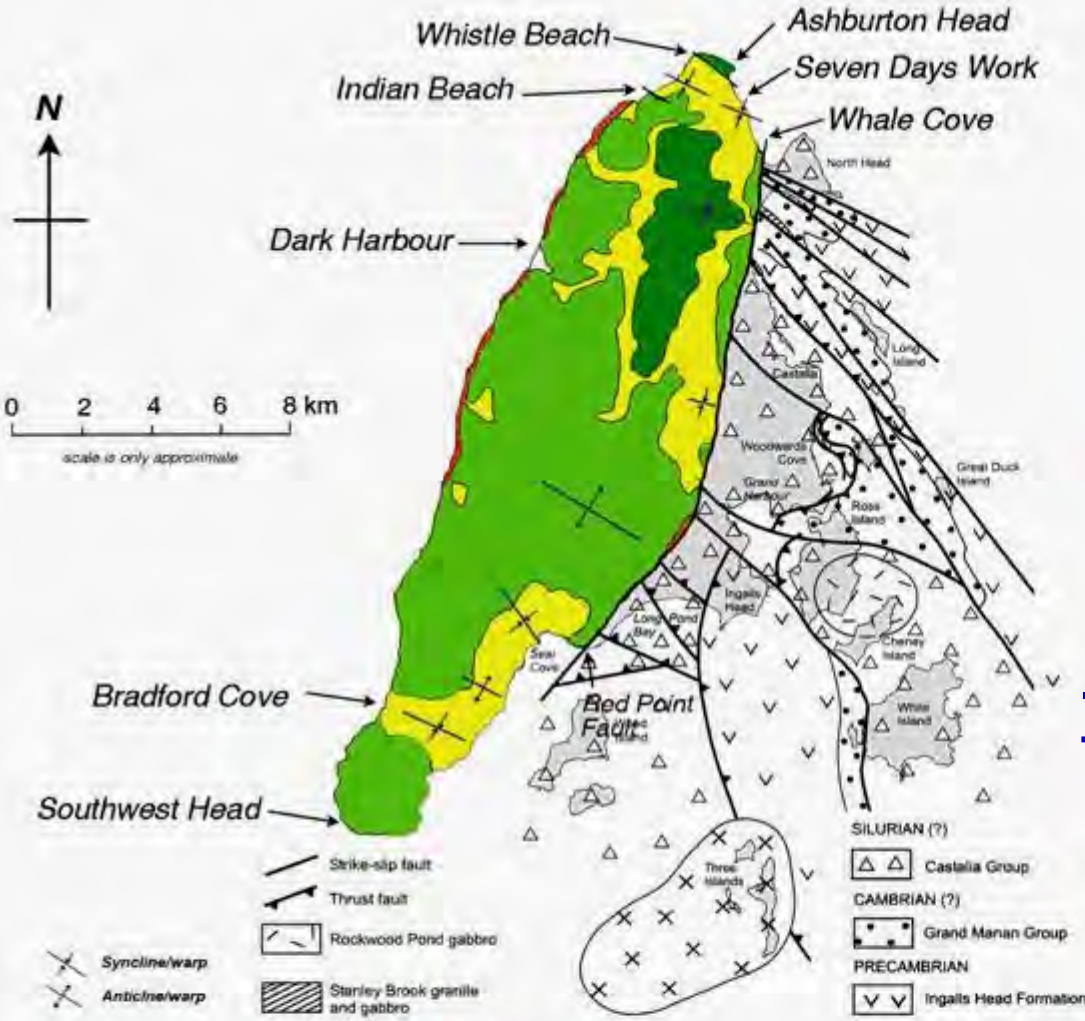


Early Jurassic igneous features of the Grand Manan region

Geology and Stratigraphy of Grand Manan Island and the southern Fundy Basin

J. G. McHone 2001 - 2005

Mesozoic map modified from G. Pajari, 1976
Pre-Mesozoic geology by Fyfe et al., 2001



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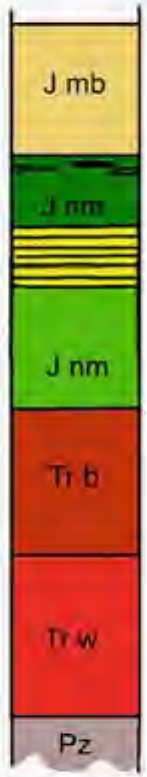


McCoy Brook ss.

upper **North**

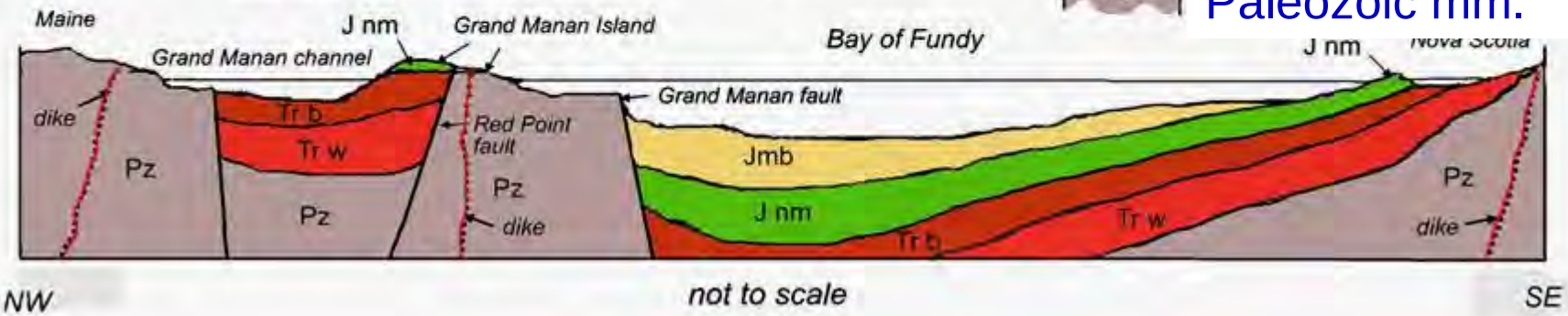
middle **Mountain**

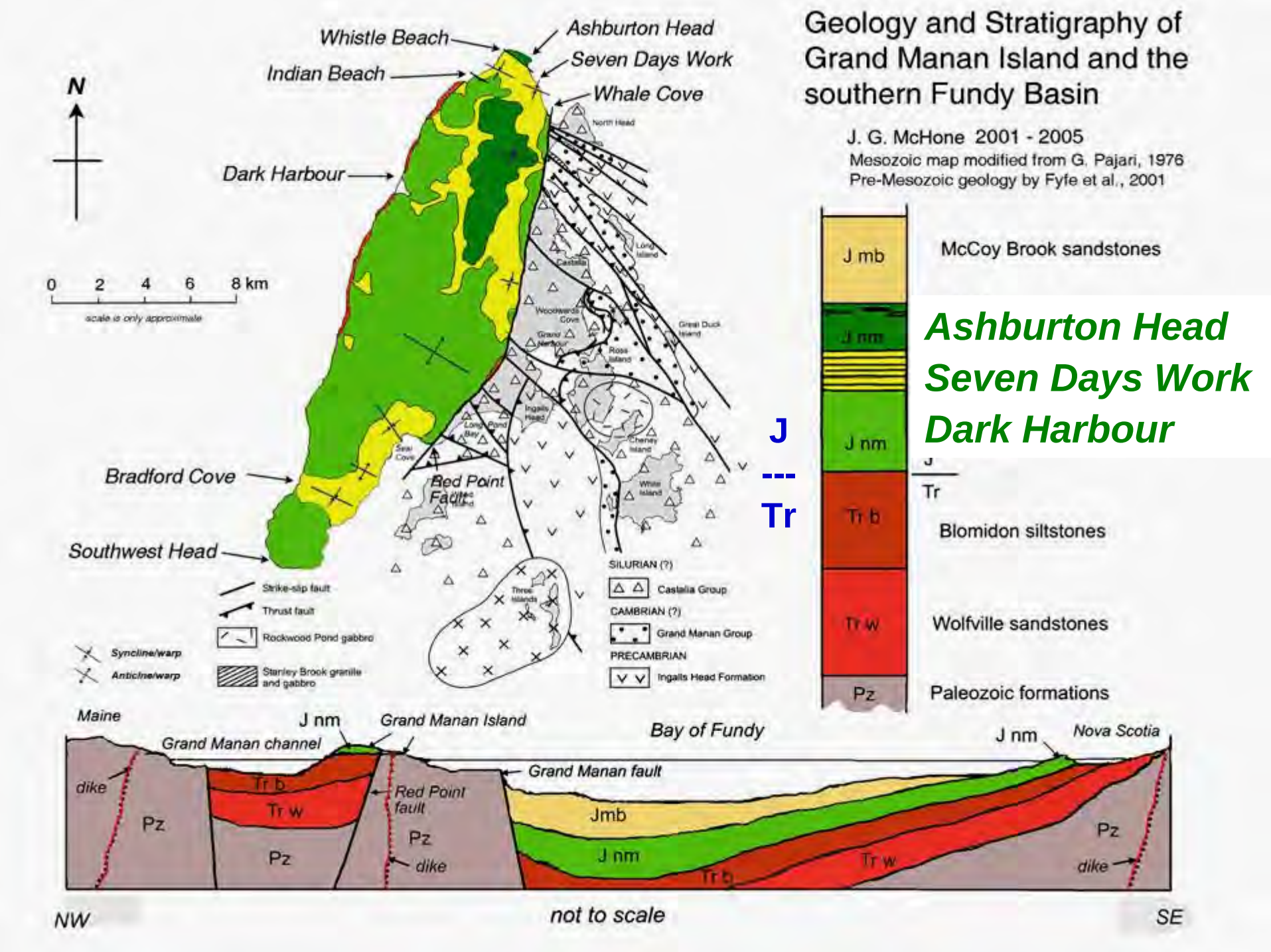
lower **Basalt**

Blomidon siltstone

Wolfville sandstone

Paleozoic mm.




Geology and Stratigraphy of Grand Manan Island and the southern Fundy Basin
J. G. McHone 2001 - 2005
Mesozoic map modified from G. Pajari, 1976
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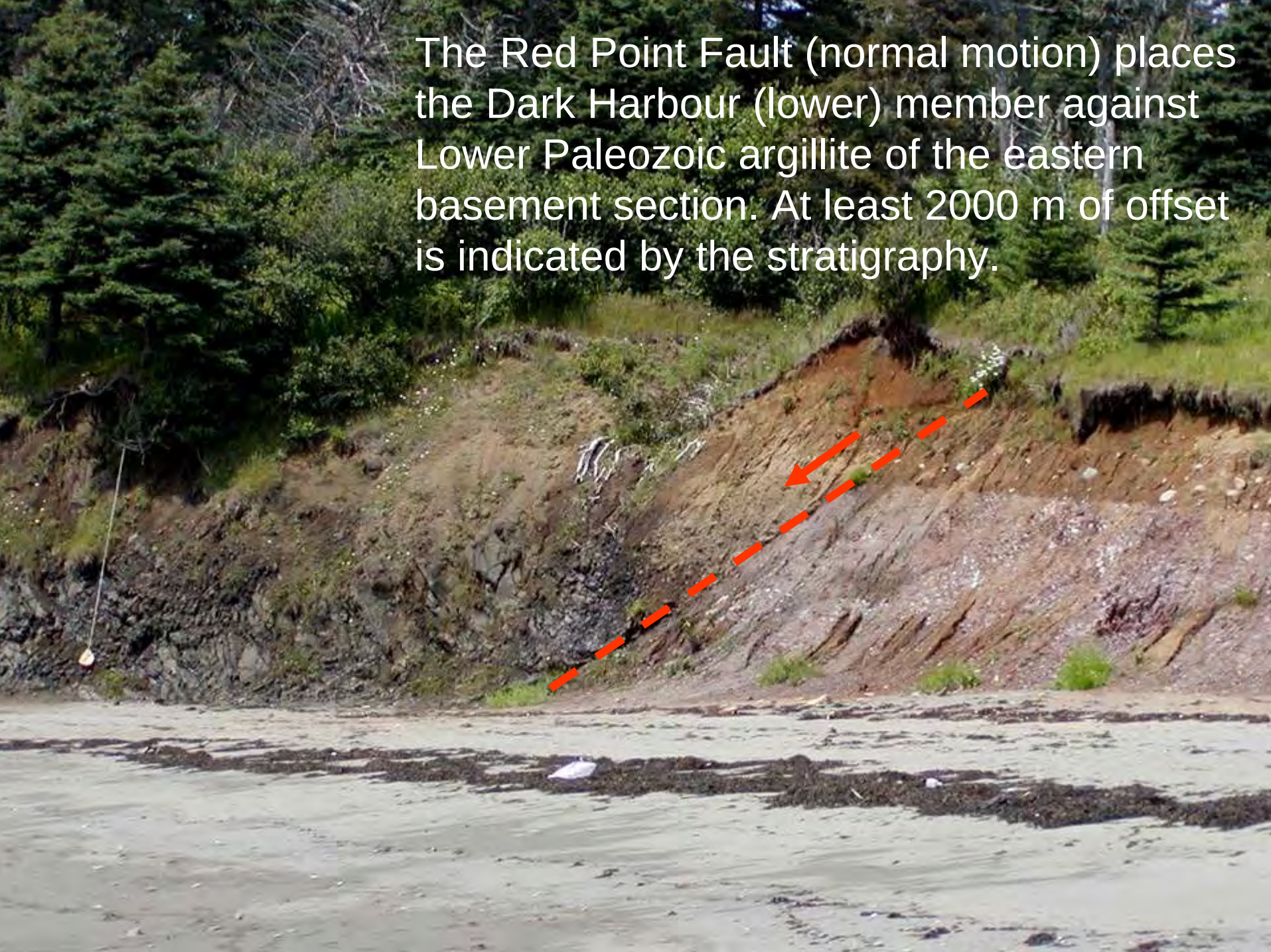
Whistle Beach
Ashburton Head
Indian Beach
Seven Days Work
Whale Cove
Dark Harbour
Bradford Cove
Red Point Fault
Southwest Head
N
0 2 4 6 8 km
scale is only approximate
Strike-slip fault
Thrust fault
Rockwood Pond gabbro
Syncline/warp
Anticline/warp
Stanley Brook granite and gabbro
SILURIAN (?)
Castalia Group
CAMBRIAN (?)
Grand Manan Group
PRECAMBRIAN
Ingalls Head Formation
J

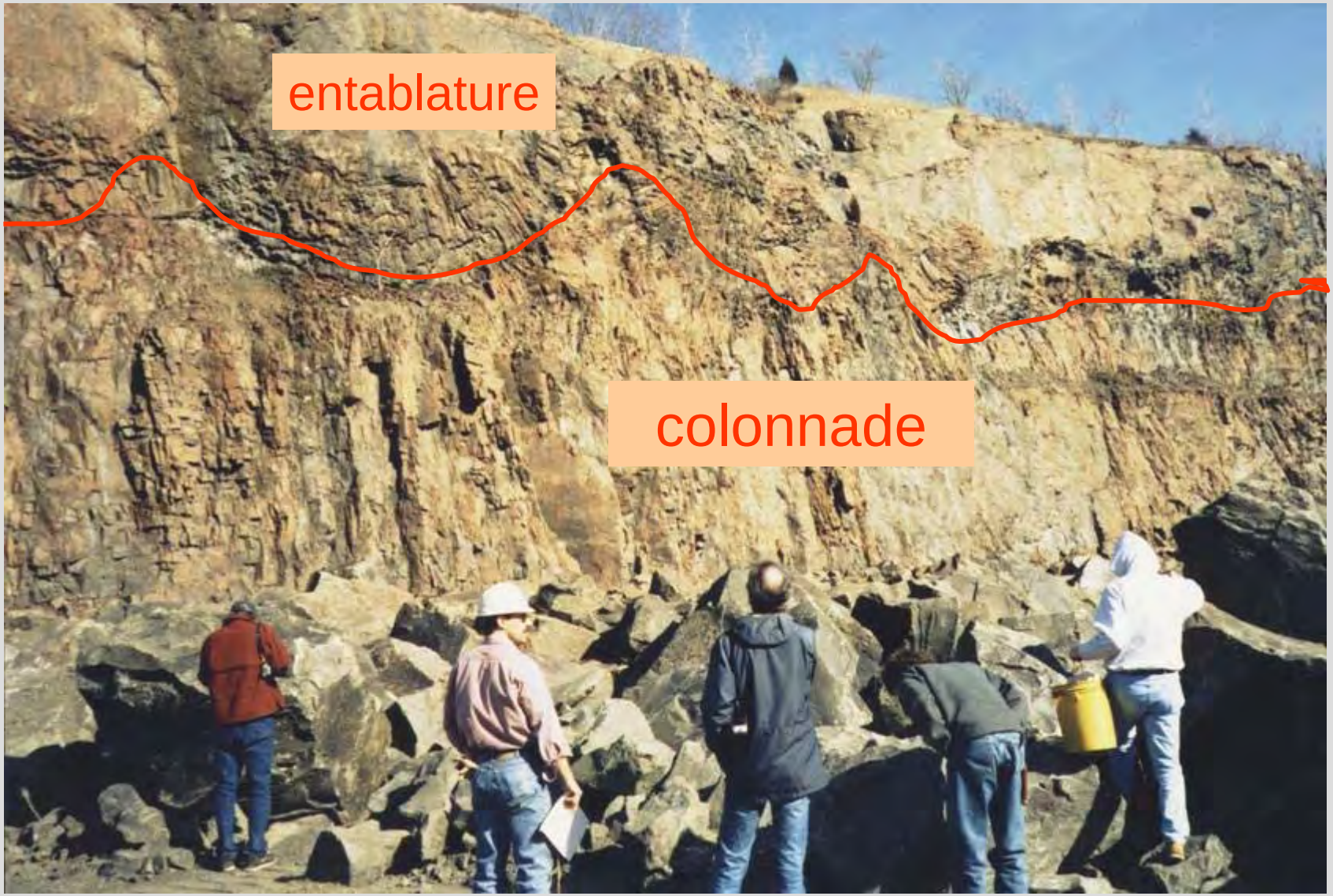
Tr
J mb
McCoy Brook sandstones
J nm
Ashburton Head
Seven Days Work
Dark Harbour
J nm
Tr
Tr b
Blomidon siltstones
Tr w
Wolfville sandstones
Pz
Paleozoic formations
Maine
J nm
Grand Manan Island
Bay of Fundy
J nm
Nova Scotia
Grand Manan channel
Grand Manan fault
dike
Tr b
Tr w
Pz
Red Point fault
Pz
dike
Jmb
J nm
Tr b
Tr w
Pz
dike
NW
not to scale
SE


The Red Point Fault (normal motion) places the Dark Harbour (lower) member against Lower Paleozoic argillite of the eastern basement section. At least 2000 m of offset is indicated by the stratigraphy.

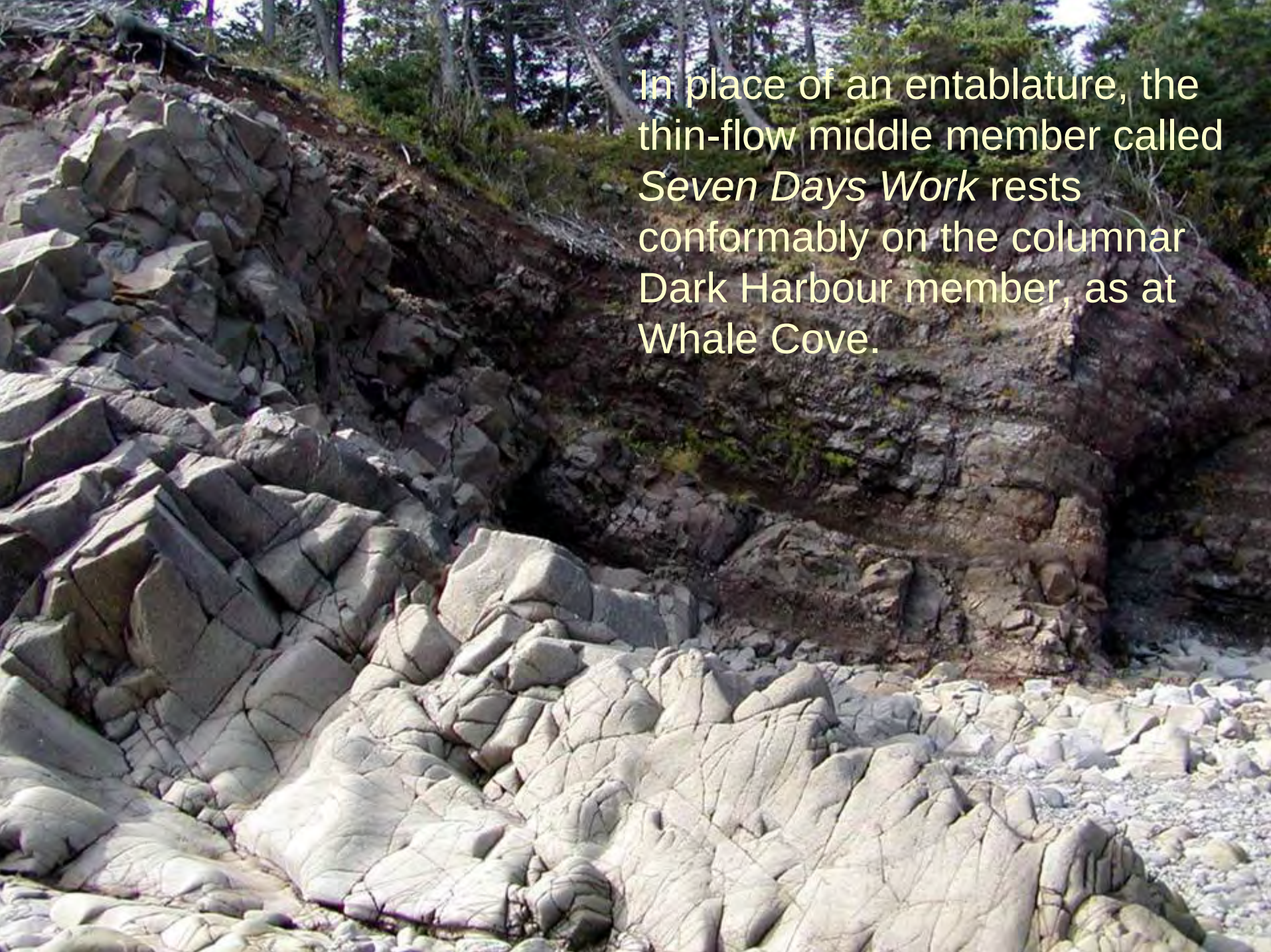
Blomidon siltstone (lower right) lies beneath the columnar Dark Harbour member (upper left), near Dark Harbour. The Tr-J boundary is in the siltstone a meter or so below the basalt.


Cliffs 70 to 110 m high of the
columnar Dark Harbour member
comprise most of the western shore

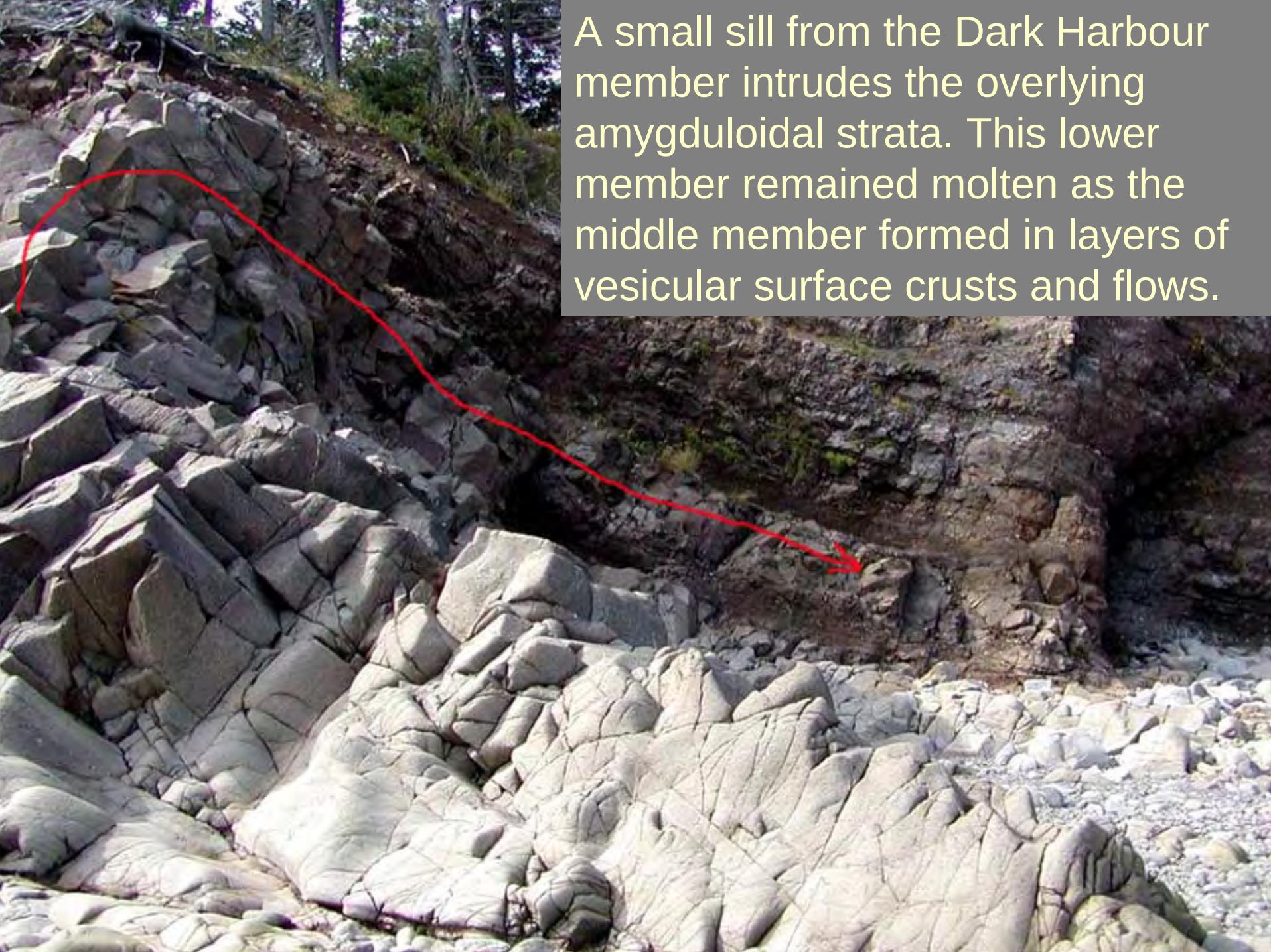

The Dark Harbour member is all colonnade, apparently lacking any entablature.



The Holyoke basalt in Connecticut is also very thick but displays an entablature above a colonnade (North Branford Quarry).



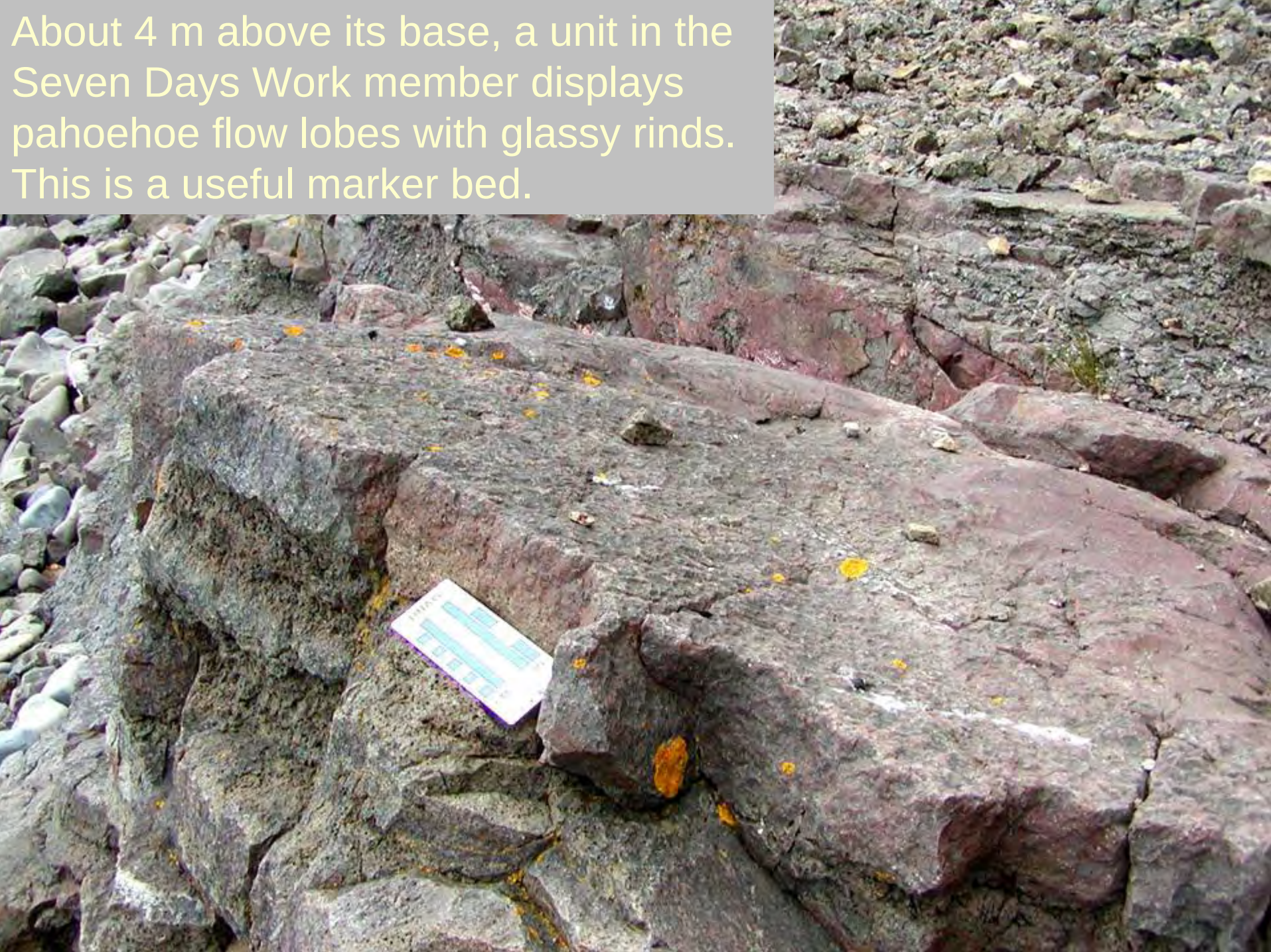
In place of an entablature, the thin-flow middle member called *Seven Days Work* rests conformably on the columnar Dark Harbour member, as at Whale Cove.



A small sill from the Dark Harbour member intrudes the overlying amygduloidal strata. This lower member remained molten as the middle member formed in layers of vesicular surface crusts and flows.


Seven Days Work is a 60-m cliff of thin amygdaloidal flows of the middle member.

About 4 m above its base, a unit in the Seven Days Work member displays pahoehoe flow lobes with glassy rinds. This is a useful marker bed.



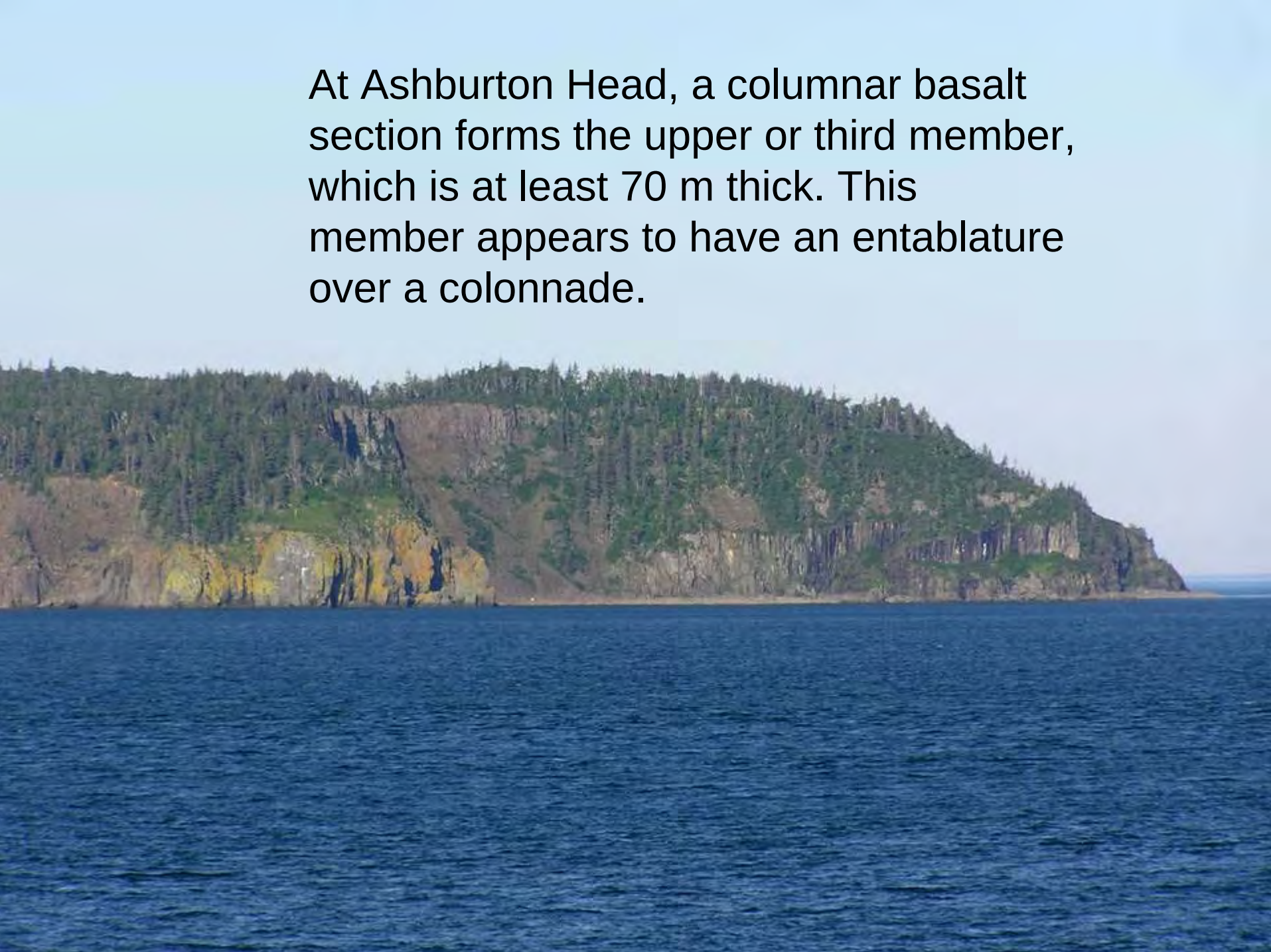

The same lobate pahoehoe flow unit
crops out again at Whale Cove

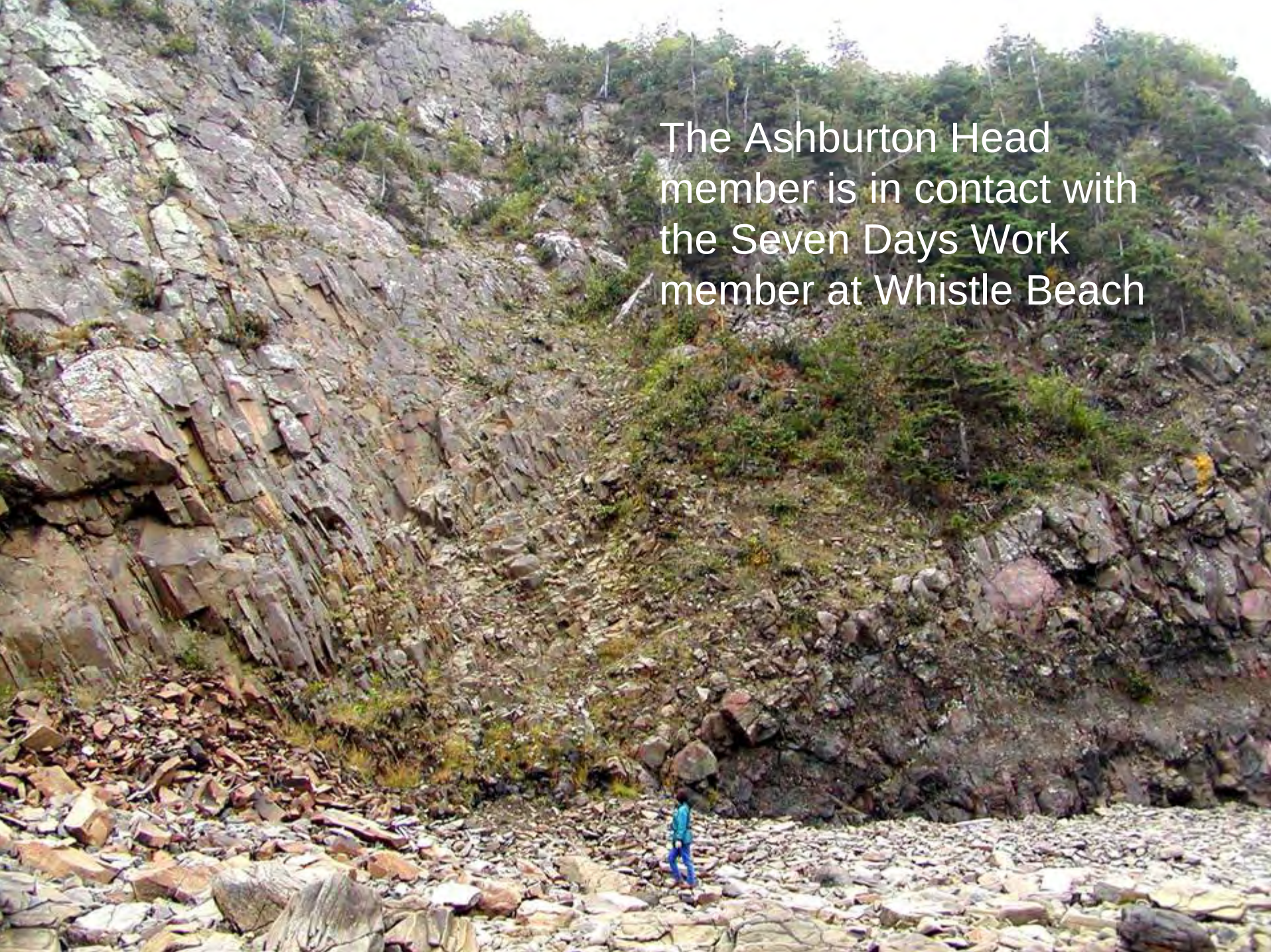
A thin amygdaloidal dike connects with a small sill at Seven Days Work.


Lava tubes at Seven Days Work,
within the middle member.

Tumulus (pressure ridge) in the middle member, Bradford Cove

At Ashburton Head, a columnar basalt section forms the upper or third member, which is at least 70 m thick. This member appears to have an entablature over a colonnade.




The Ashburton Head member is in contact with the Seven Days Work member at Whistle Beach

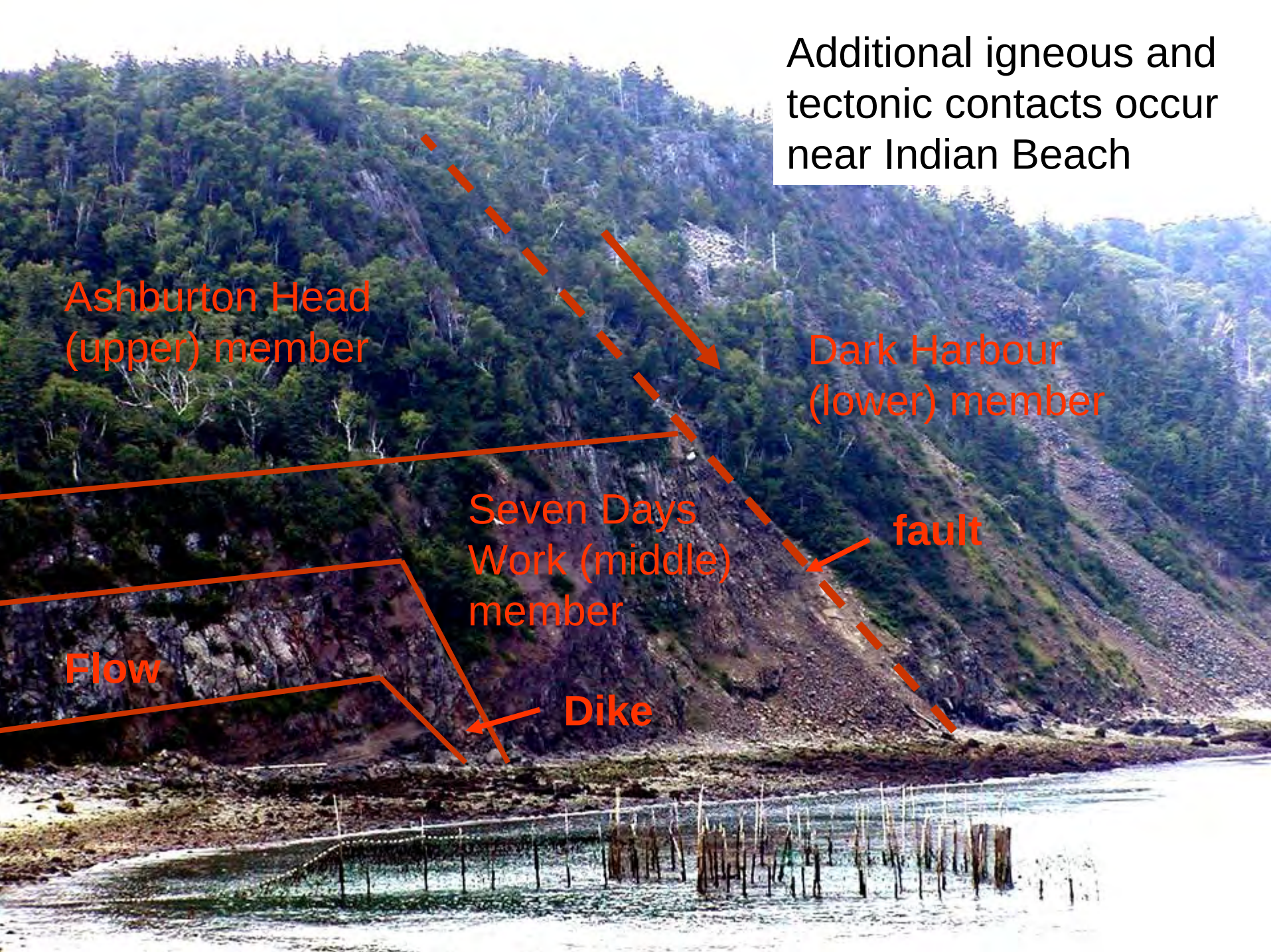

Finger-like pipe amygdules at the base of the Ashburton Head (upper) member show an igneous cross-cutting contact with the Seven Days Work (middle) member.


Contact at The Whistle Beach
Upper Columnar Member
Igneous Contact
Middle Member Strata


However, a normal fault, with slickensides, parallels the igneous contact about 1 meter above it.


Contact at The Whistle Beach
Upper Columnar Member
Tectonic contact
Igneous Contact
Middle Member Strata

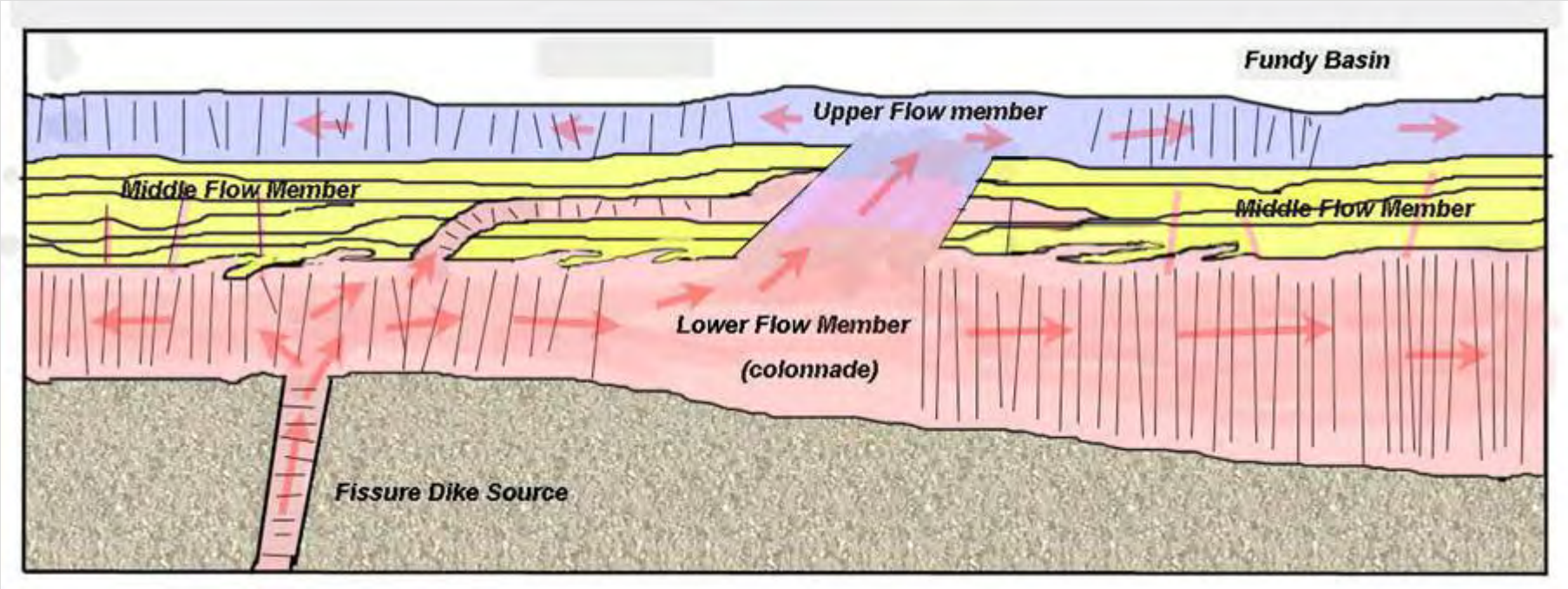

Additional igneous and
tectonic contacts occur
near Indian Beach


Additional igneous and tectonic contacts occur near Indian Beach
Ashburton Head (upper) member
Dark Harbour (lower) member
Seven Days Work (middle) member
fault
Flow
Dike


Flow
Seven Days
Work (middle)
member
Seven Days
Work (middle)
member
Dike


Seven Days Work (middle) member
The intrusion must be from the Dark Harbour (lower) member basalt

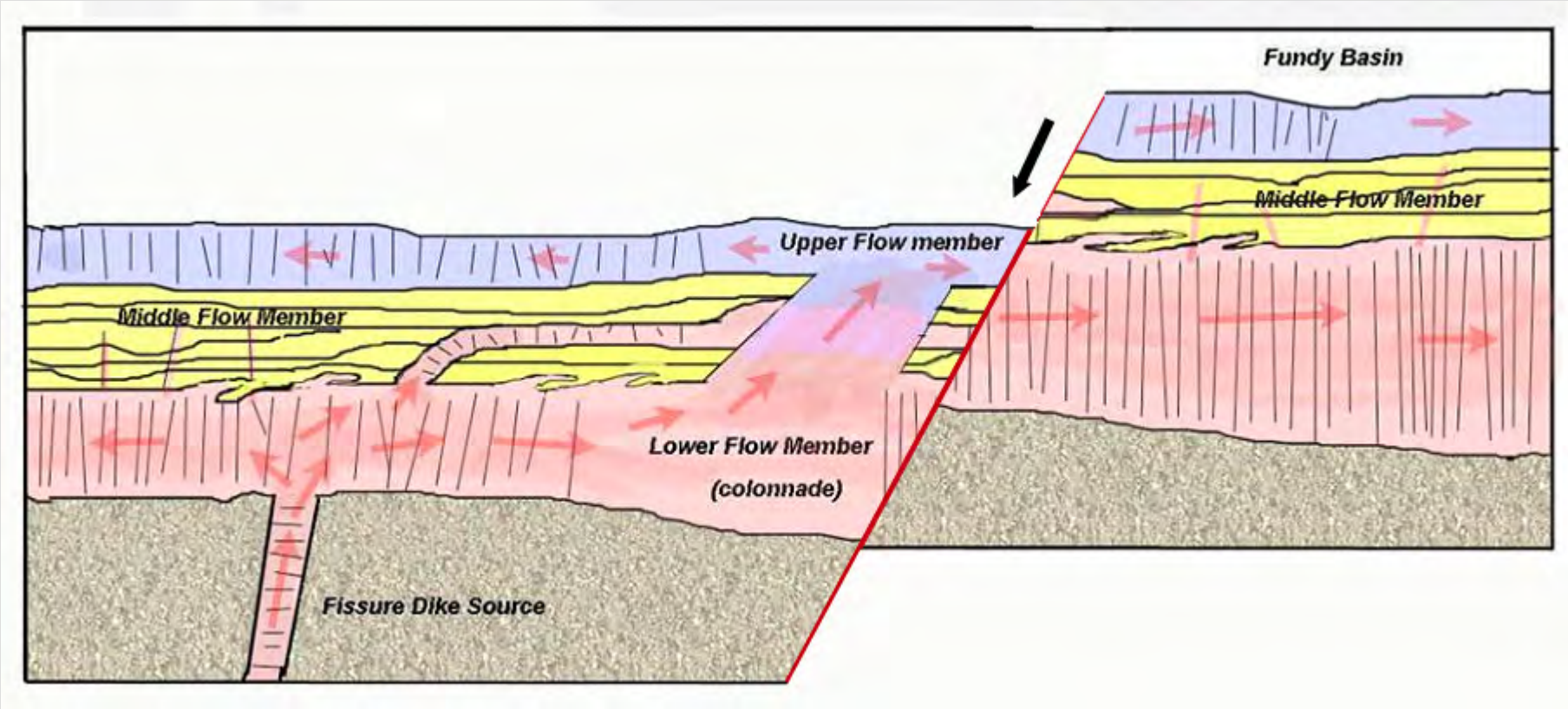

Ashburton Head member
Dark Harbour member
Seven Days Work member



1. Fissures (dikes) first fed the thick lower member, which filled the nascent Fundy Basin (already a topographic low)

2. A series of thin gas-rich vesicular cap flows (the middle member) were created from the lower member by repeated inflations or surges of magma from the source fissures.

3. A large surge broke through the middle member to form the third or upper member.



4. Tectonic activity during and after the magmatic activity produced some of the contacts between members and formations.