Correlation of the Sedimentary and Tectonic Evolution at the North American Margin, on Svalbard, and on the New Siberian Islands in the Last 650 Million Years*

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Search and Discovery Article #30303 (2013)**
Posted December 9, 2013

*Adapted from an oral presentation given at AAPG 3P Arctic Polar Petroleum Potential Conference & Exhibition, Stavanger, Norway, October 15-18, 2013

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Abstract

The comparison and correlation of the sedimentary development and tectonic events in the exotic terrain Pearya (i), on Ellesmere Island (ii), in North Greenland (iii), on Svalbard (iv), and on the New Siberian Islands (v) show differences or similarities concerning the history and evolution since Late Neoproterozoic times. In the Late Neoproterozoic and Early Paleozoic, Svalbard (iv) and Pearya (i) were closely connected as indicated by the occurrence of Vendian diamictites (tillites) and the Paleozoic sedimentary successions. At the same time, the deposition of the Franklinian Basin on Ellesmere Island (ii) and North Greenland (iii) formed the passive northern continental margin of Laurentia without any evidence for Caledonian tectonics. In the Earliest Carboniferous, the Ellesmerian/Svalbardian deformation was the result of the approach and docking of Pearya/Svalbard (i, iv) against the northern margin of Laurentia (ii, iii). This compressive deformation affected the infill of the Franklinian Basin as well as the Caledonian Orogen and the post-Caledonian Old Red-basins on Svalbard.

Between the Ellesmerian/Svalbardian and the Tertiary Eurekan deformations, the evolution in all four areas was similar. The development of the Sverdrup Basin (i, ii), the Wandel Hav Basin (iii) and the Spitsbergen Central Basin (iv) was initiated by extensional tectonics and the formation of fault-bounded basins and was followed by carbonate and clastic sedimentation since the Late Carboniferous and through Mesozoic times. During the break-up of Laurasia and the formation of the Arctic and North Atlantic oceans, all four areas were affected by the Early Tertiary Eurekan Deformation (i, ii, iii) and the formation of the West Spitsbergen Fold-and-Thrust Belt (iv). This complex intracontinental deformation between the North American, Greenland and Eurasian plates represents the last tectonic event which affected all four areas. As a result of the opening of the Arctic Ocean, Pearya (i) remained at the northern margin of Ellesmere Island and became part of the North American Plate (ii, iii). Since the termination of the Eurekan Deformation in the Late Eocene/Early Oligocene, the geological evolutions of Pearya, Ellesmere Island and North Greenland (i, ii, iii) on the one hand and Svalbard (iv) on the other are again different. The sedimentary and structural development of the New Siberian Islands (v) is absolutely different from the above four areas: the basin development started in Cambrian times and continued without important breaks until the Early Cretaceous. Evidence for the Caledonian

Orogeny and the Ellesmerian/Svalbardian deformation is lacking. The tectonic activity in Cretaceous/Tertiary times started before the separation of the Lomonosov Ridge from the Eurasian continental margin and is more likely related to the closure of the South Anyui Suture Zone, the opening of the Amerasian Basin, and the onset of formation of the Laptev Sea Rift.

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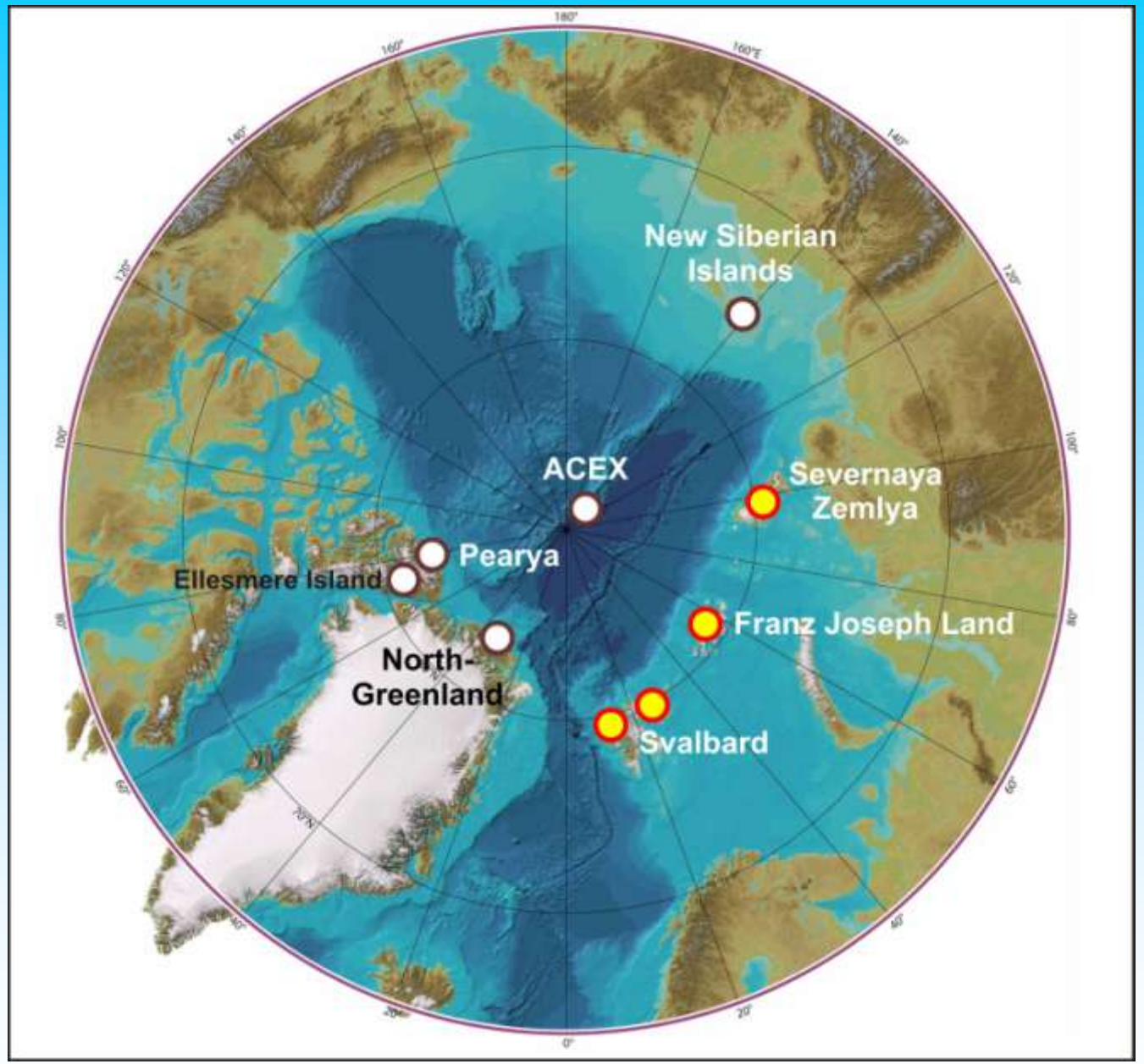

Jakobsson et al. (2008)

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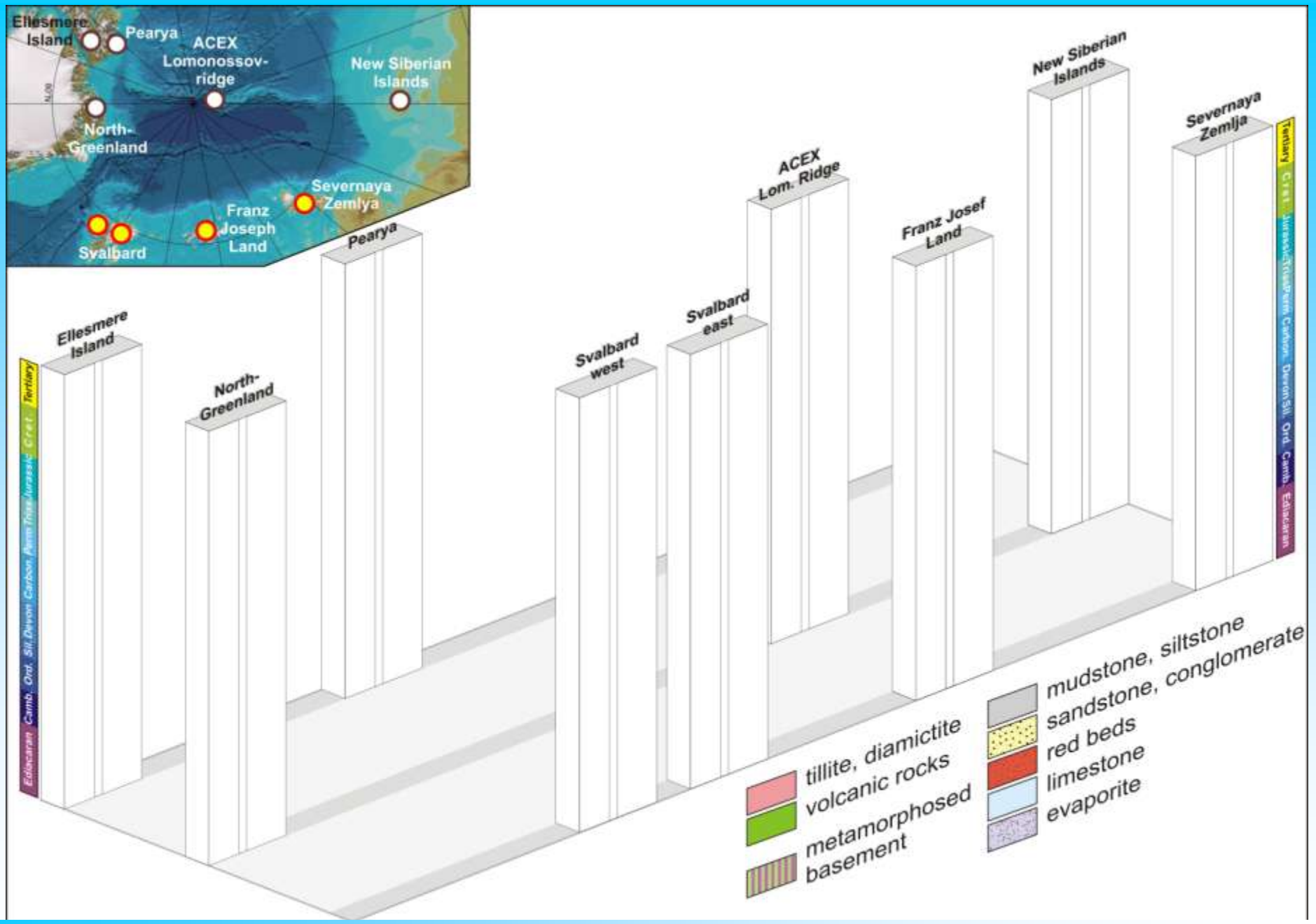

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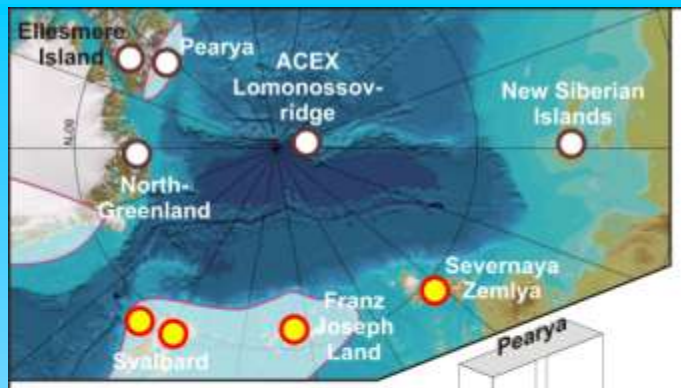
Caledonian Orogeny



Ordovician and Silurian

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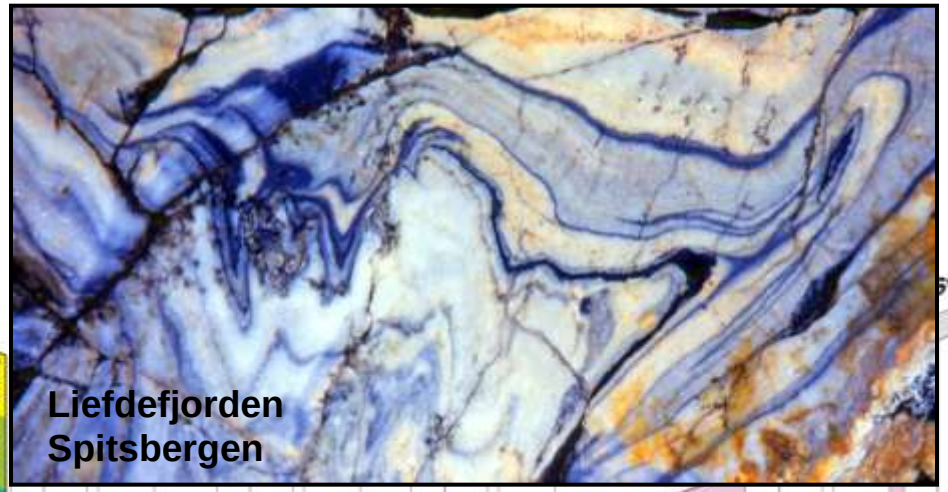
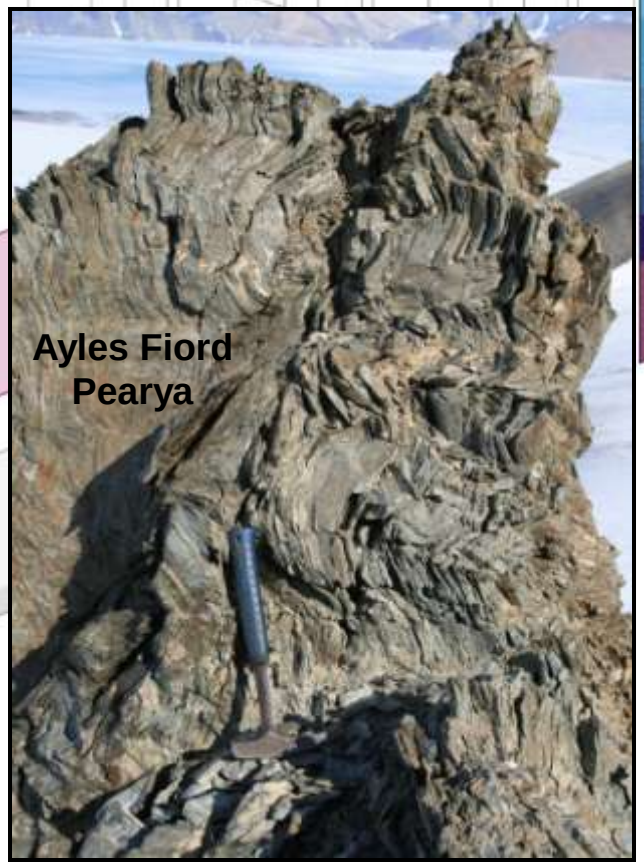
Caledonian Orogeny



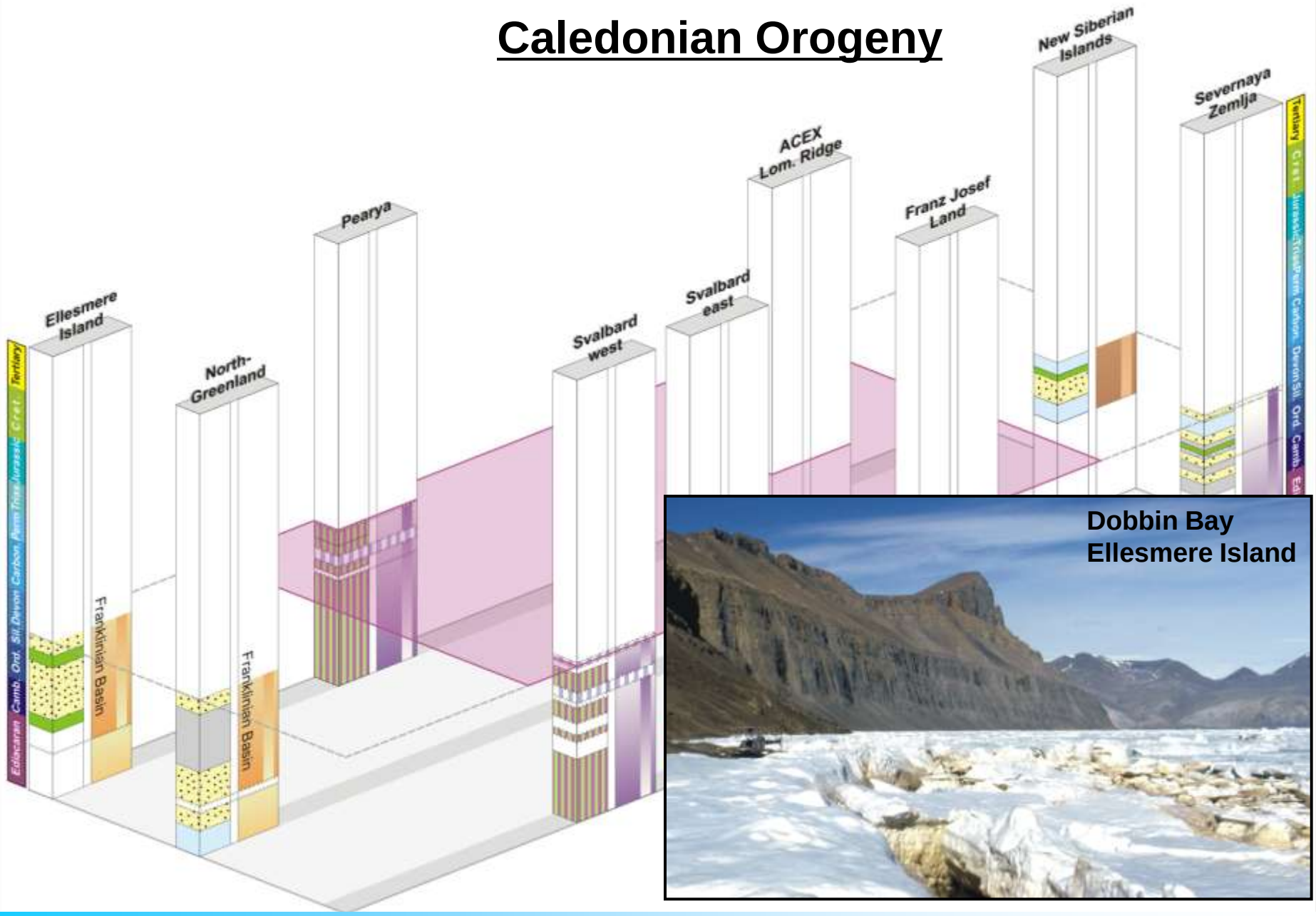
Liefdefjorden
Spitsbergen



Ayles Fiord
Pearya

Ordovician and Silurian

Caledonian Orogeny



Ordovician and Silurian

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Caledonian Orogeny

Photo: Chr. Gaedicke

Paleozoic sandstone
Central Kothel'ny Island

Ordovician and Silurian

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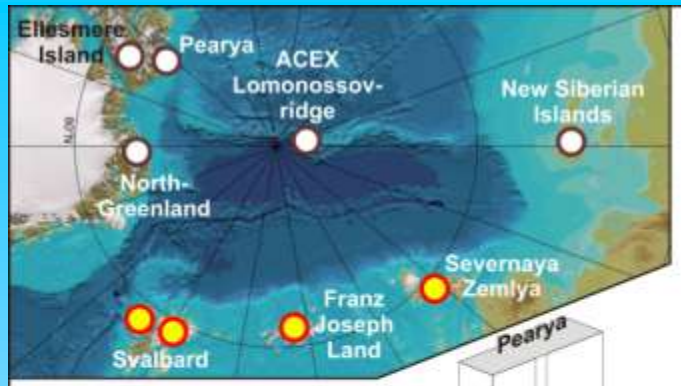
Old Red-Basins



Late Silurian and Devonian

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Old Red-Basins

Late Silurian and Devonian

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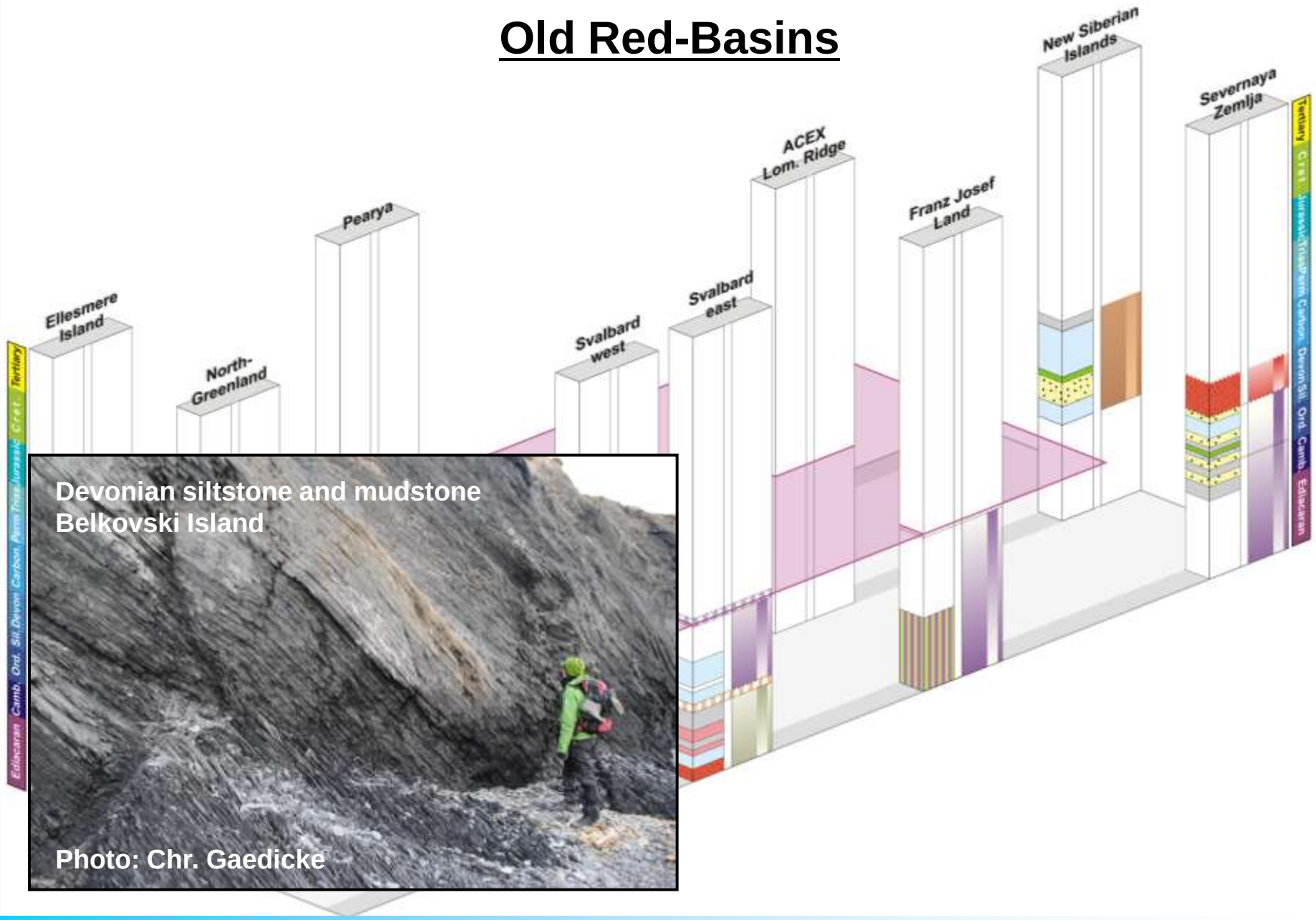
Old Red-Basins



Late Silurian and Devonian

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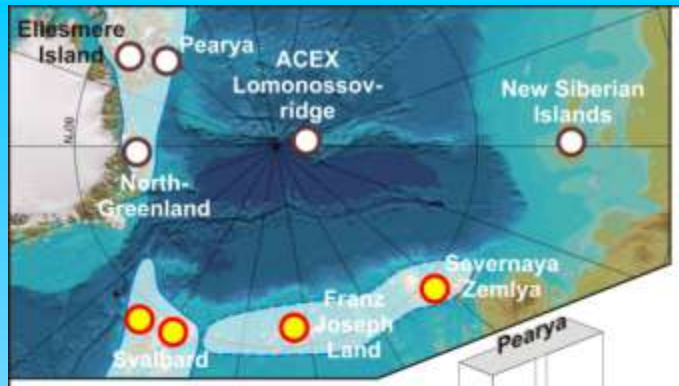
Ellesmerian Deformation



Early Carboniferous

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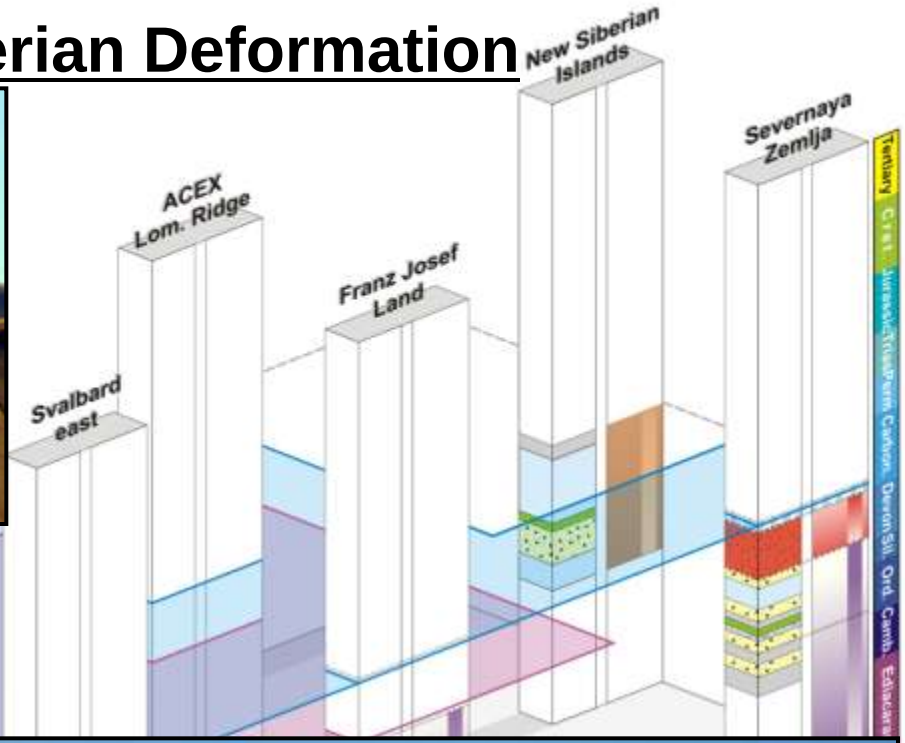
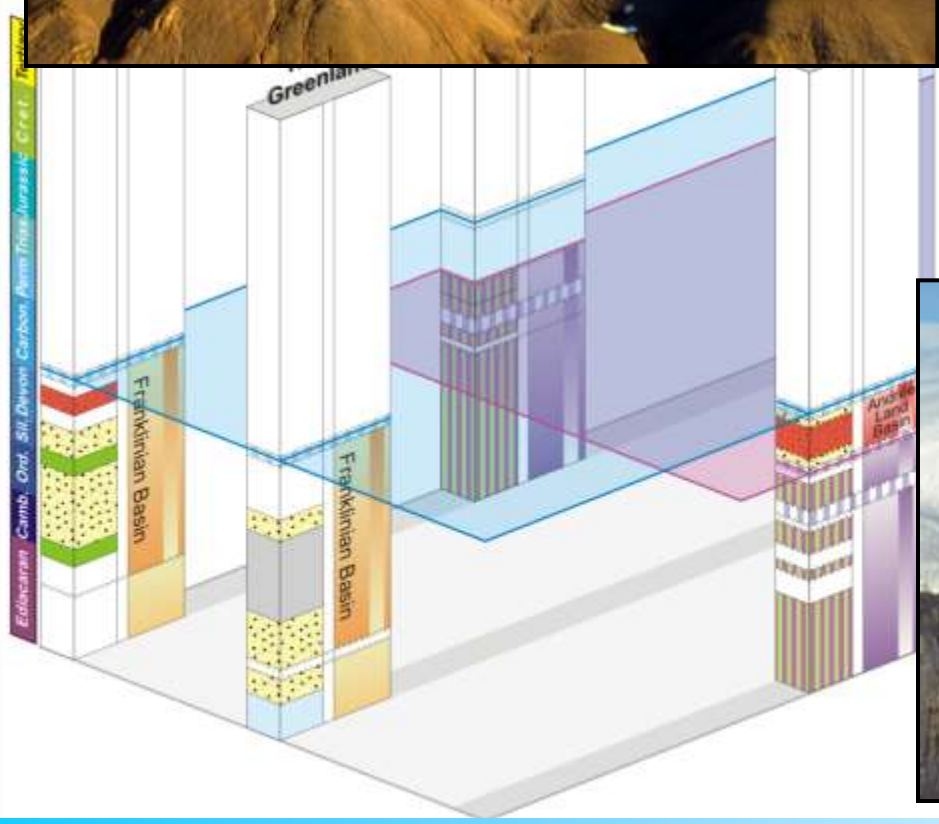
Ellesmerian Deformation





Early Carboniferous

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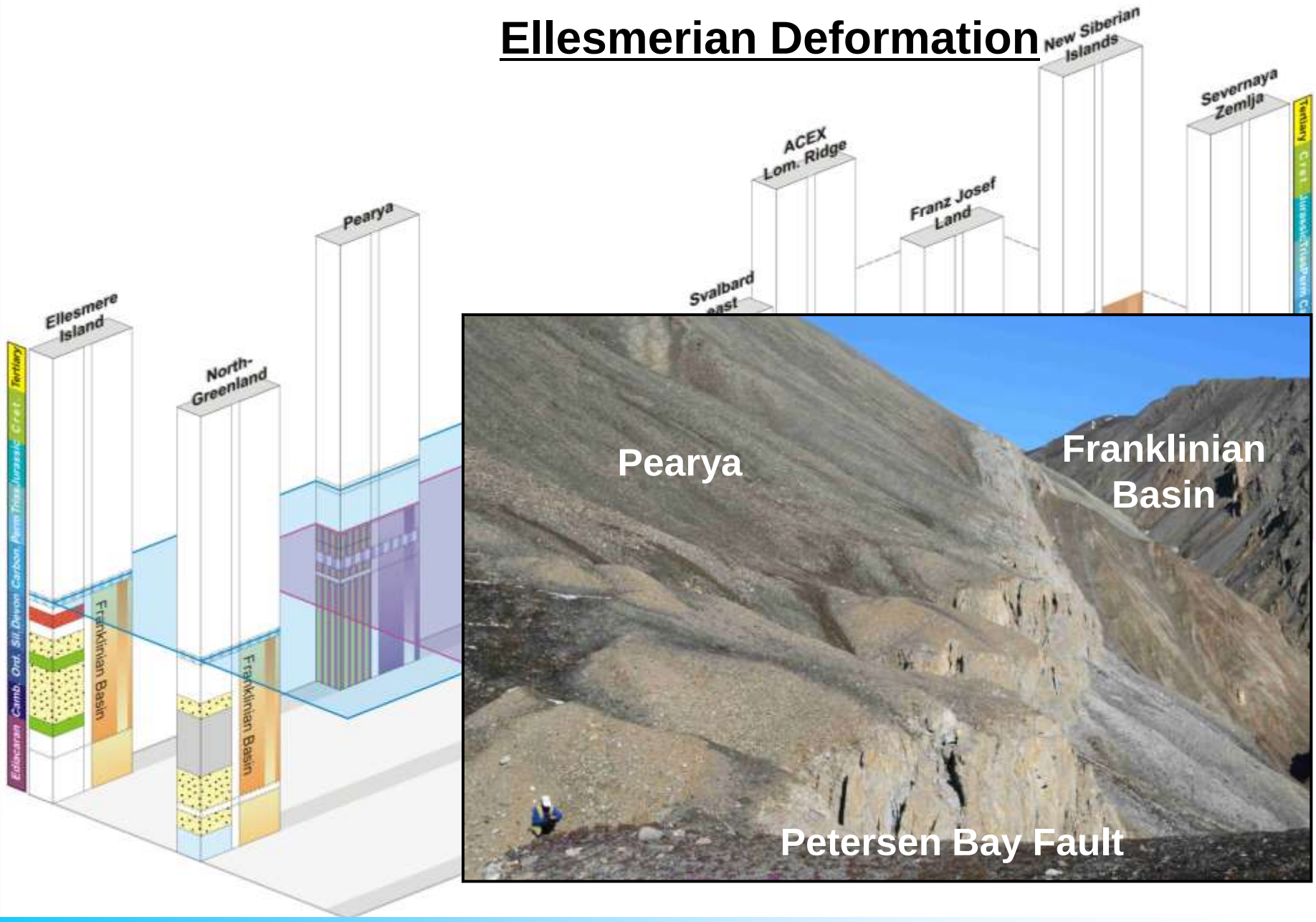
Ellesmerian Deformation



Early Carboniferous

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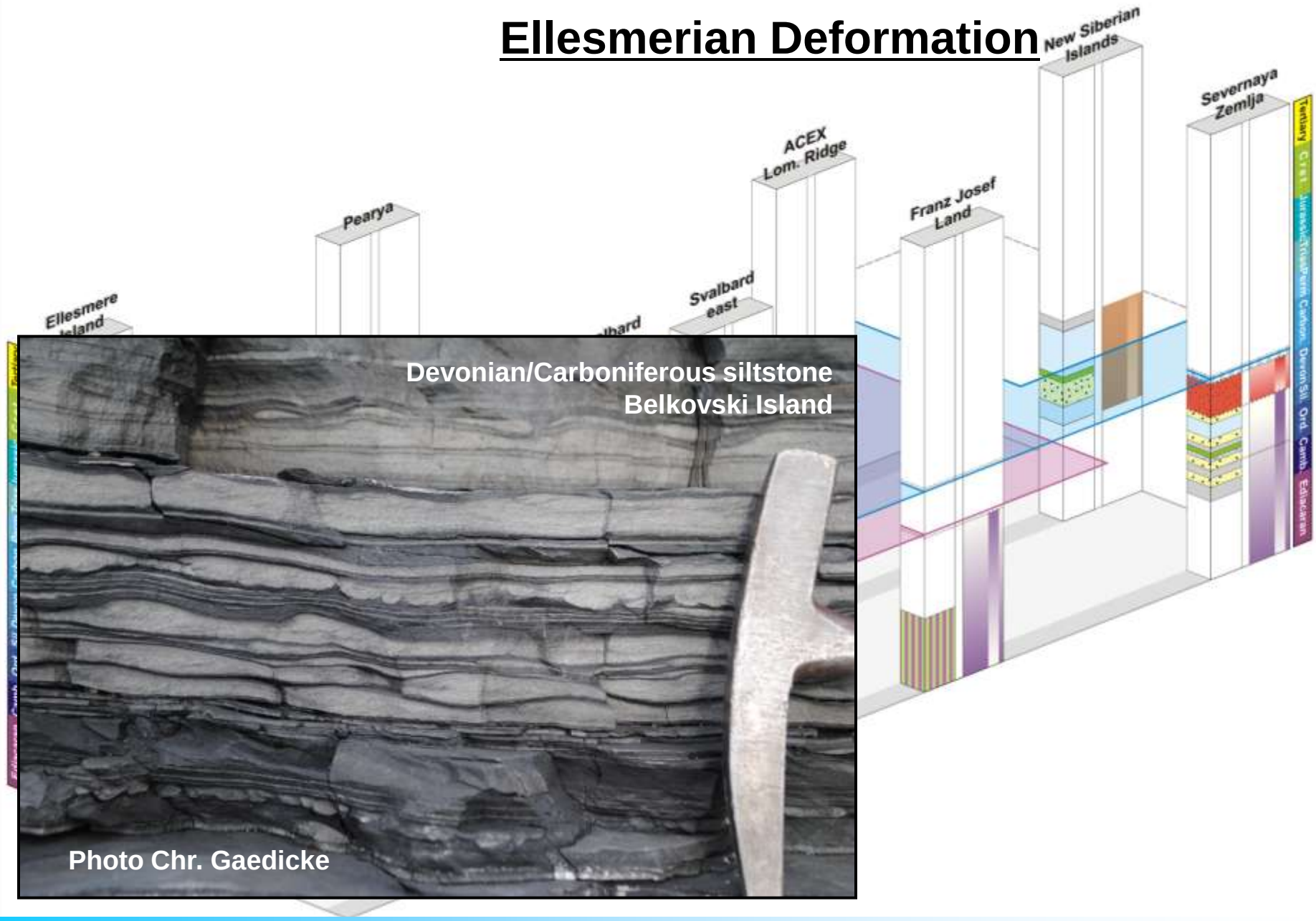
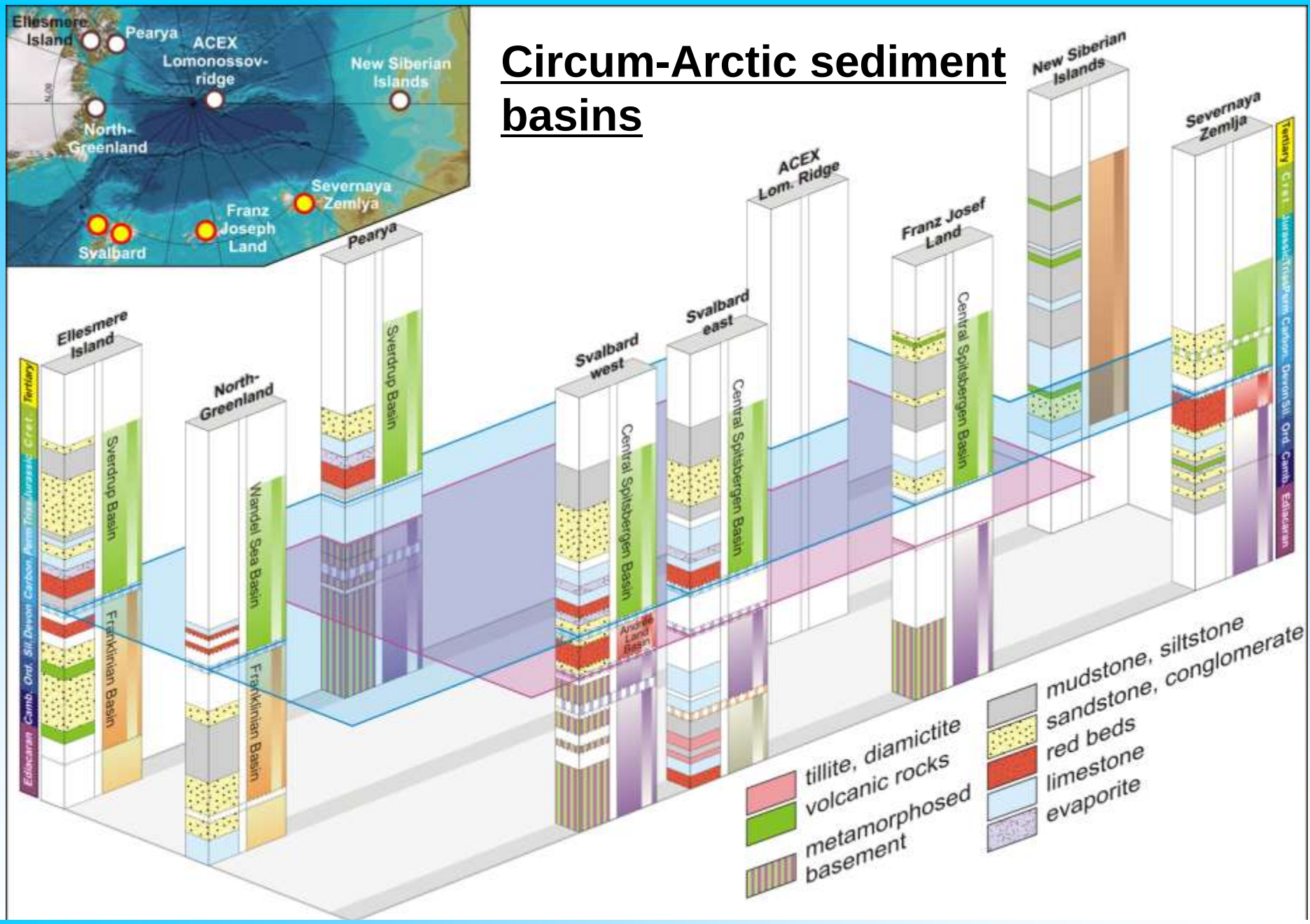
Ellesmerian Deformation



Early Carboniferous

Circum-Arctic sediment basins



Early Carboniferous to Cretaceous

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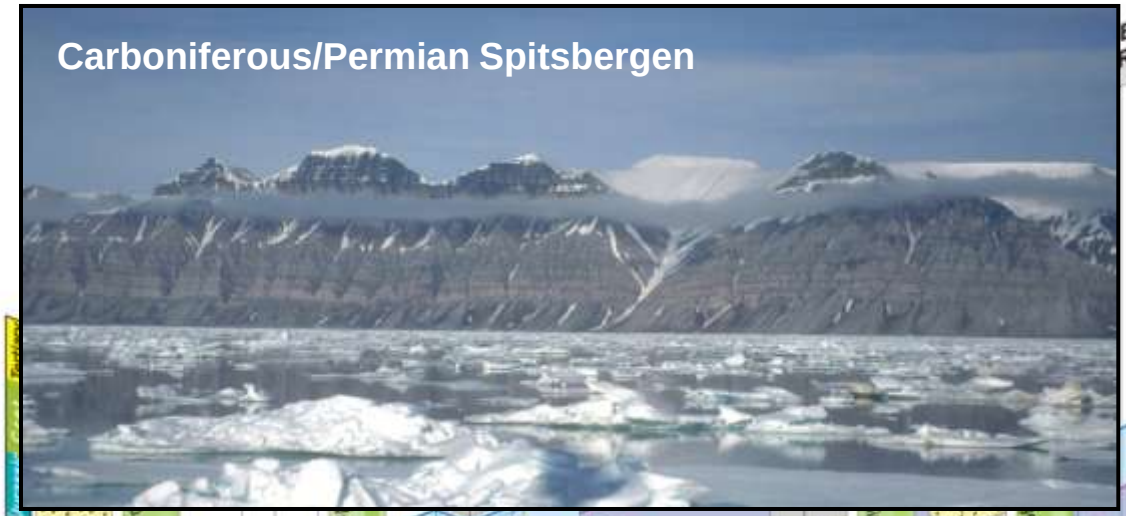
Circum-Arctic sediment basins



Early Carboniferous to Cretaceous

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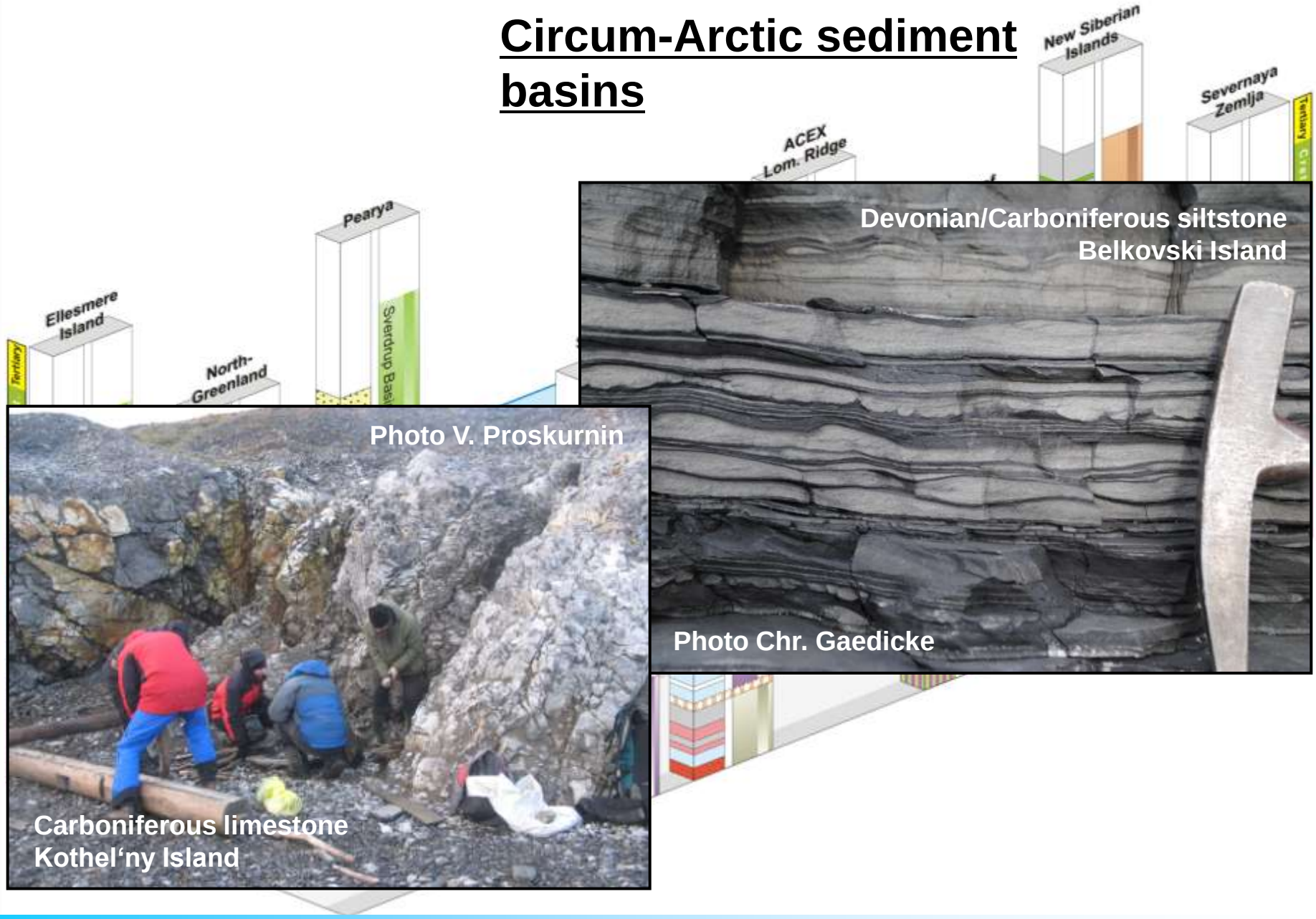
Circum-Arctic sediment basins



Devonian/Carboniferous siltstone
Belkovski Island

Photo Chr. Gaedicke

Photo V. Proskurnin

Carboniferous limestone
Kothel'ny Island

Early Carboniferous to Cretaceous

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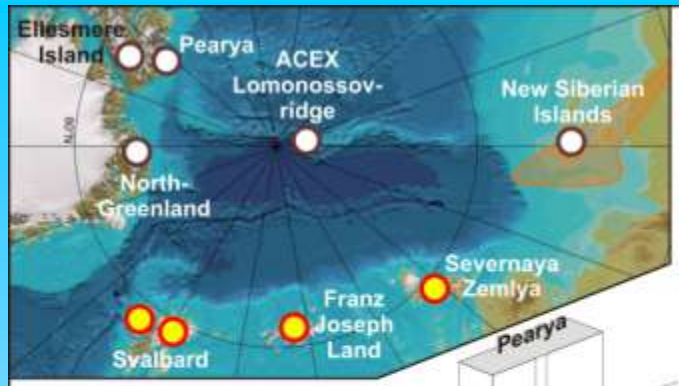
Deformation on the New Siberian Islands



Early Cretaceous

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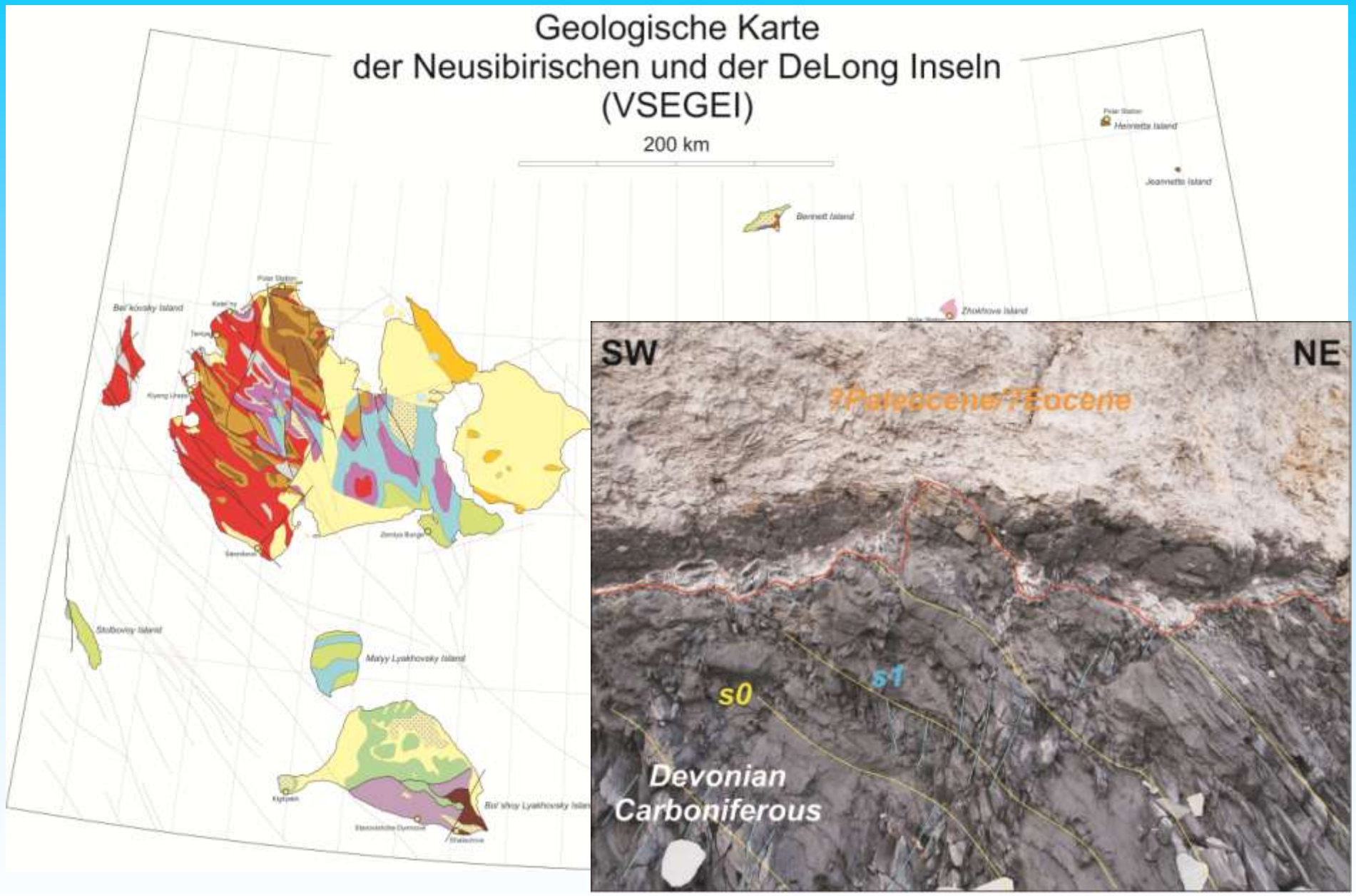
Geologische Karte der Neusibirischen und der DeLong Inseln (VSEGEI)



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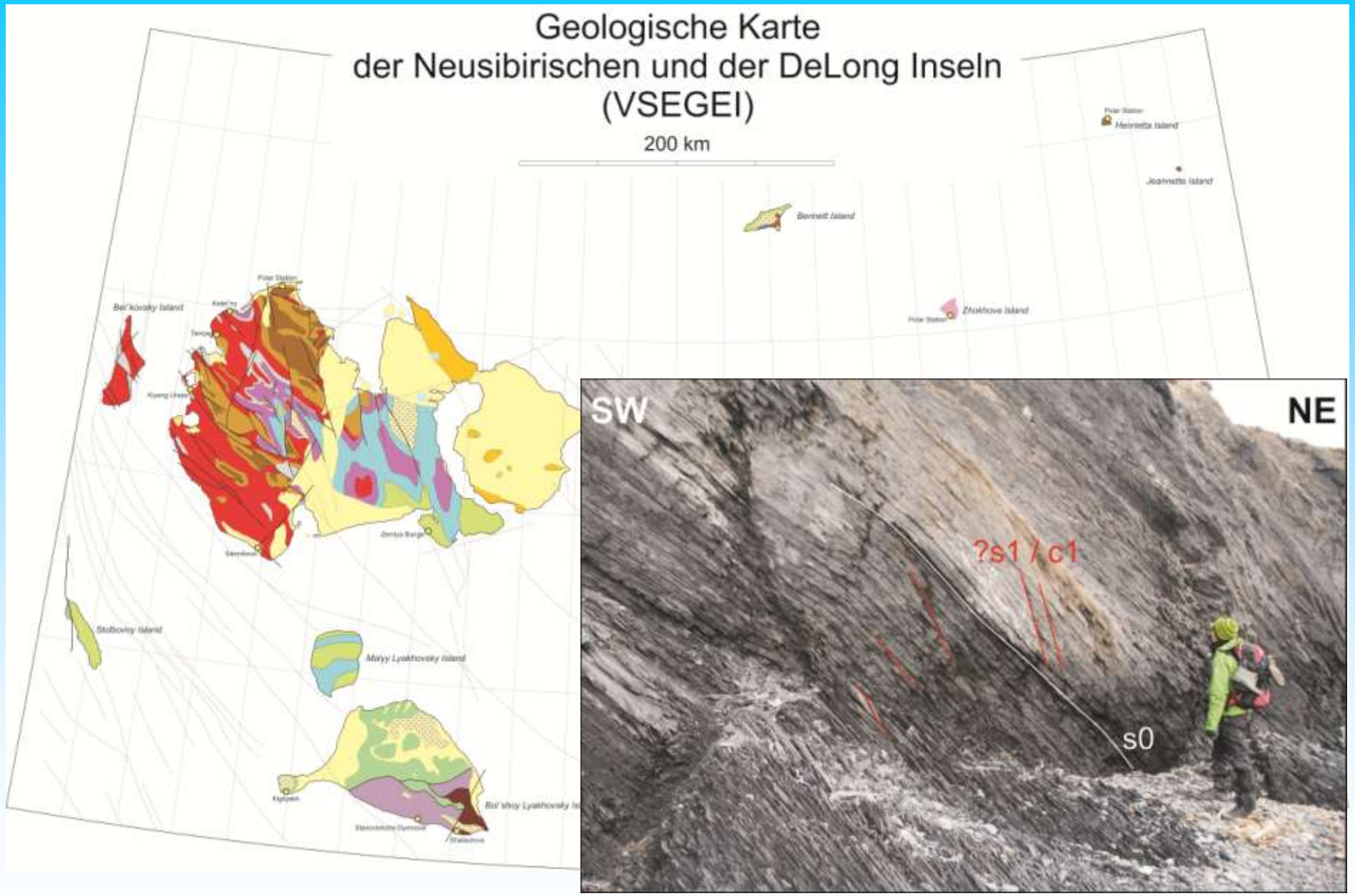

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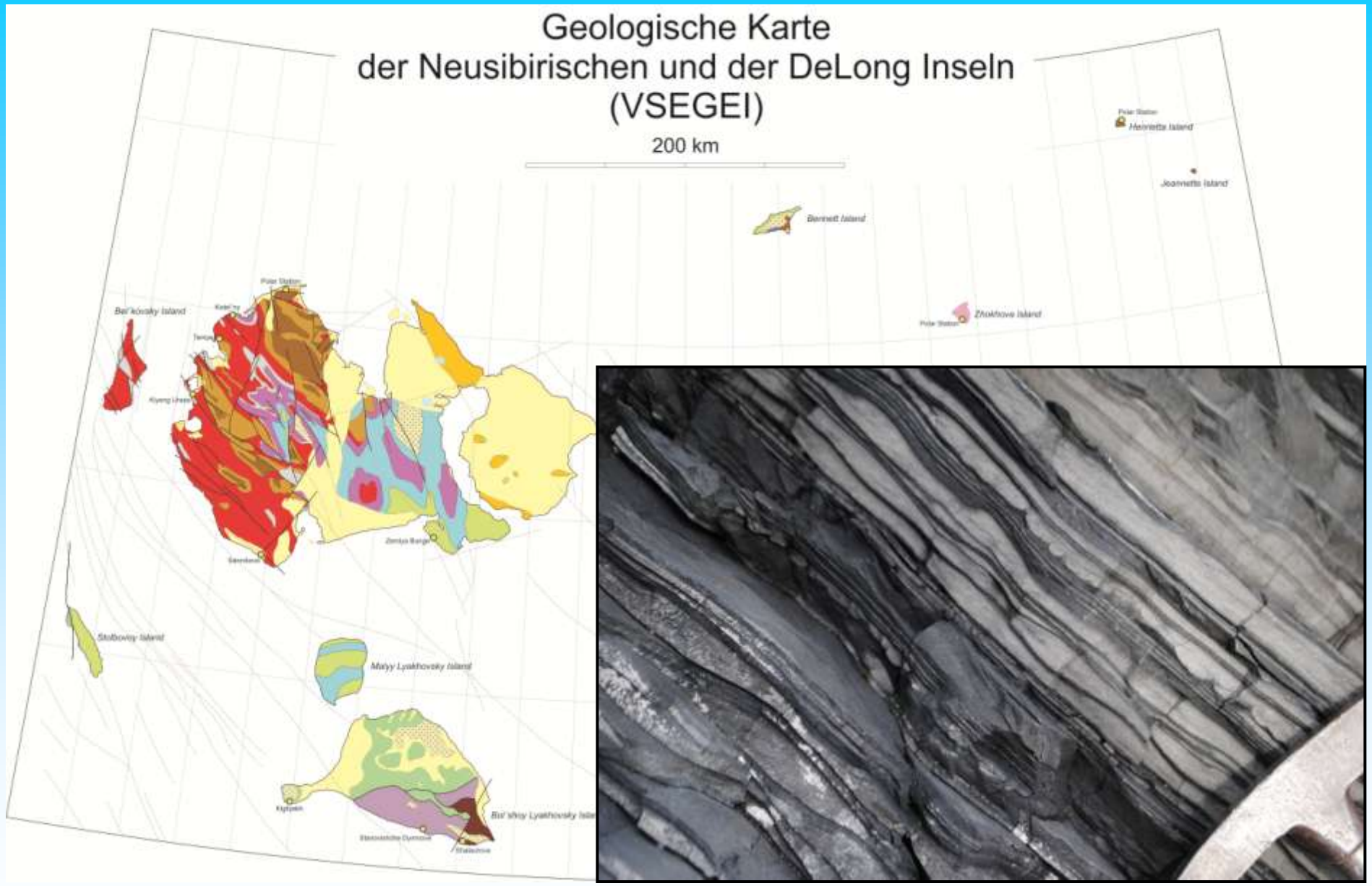

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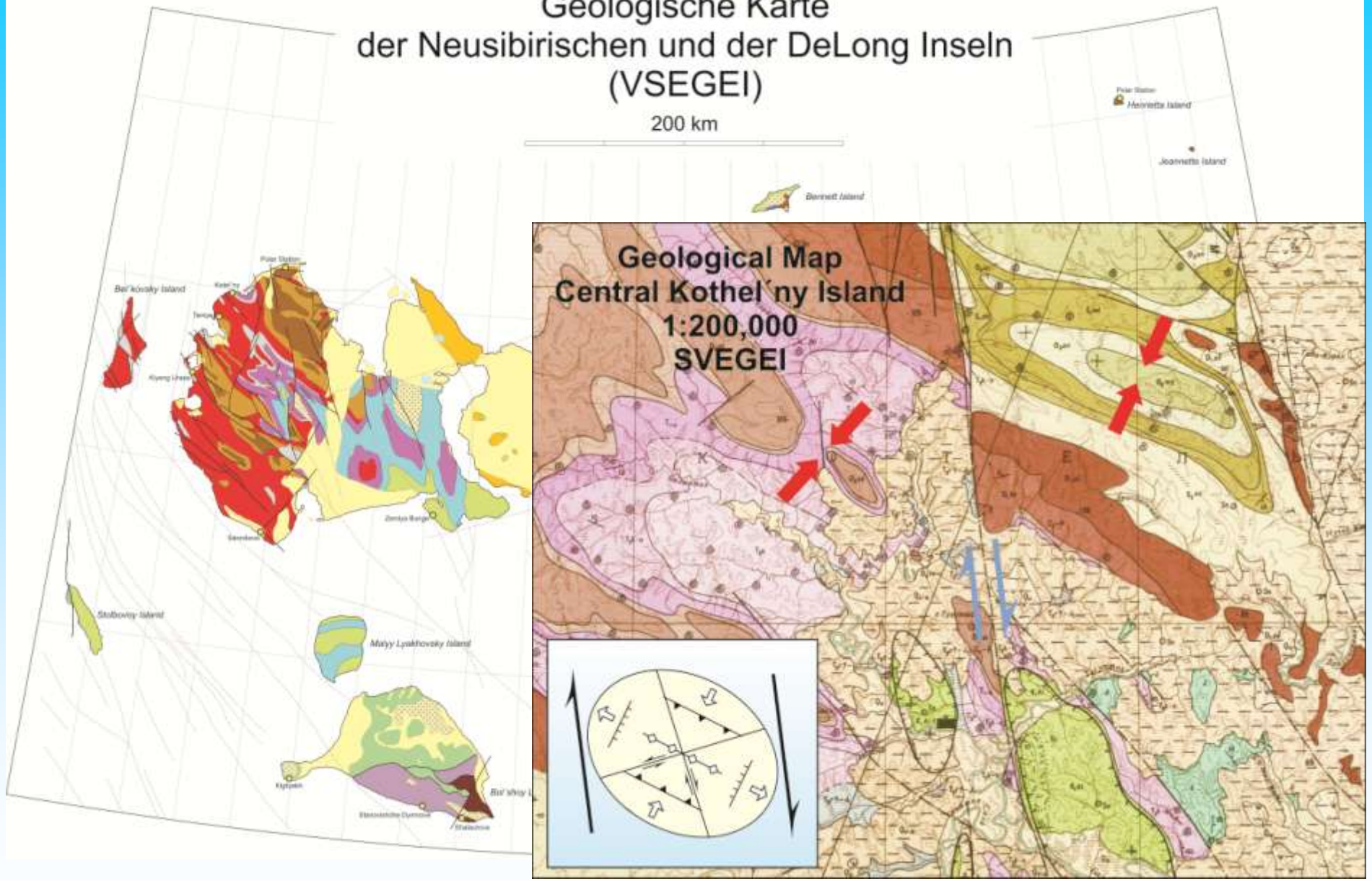

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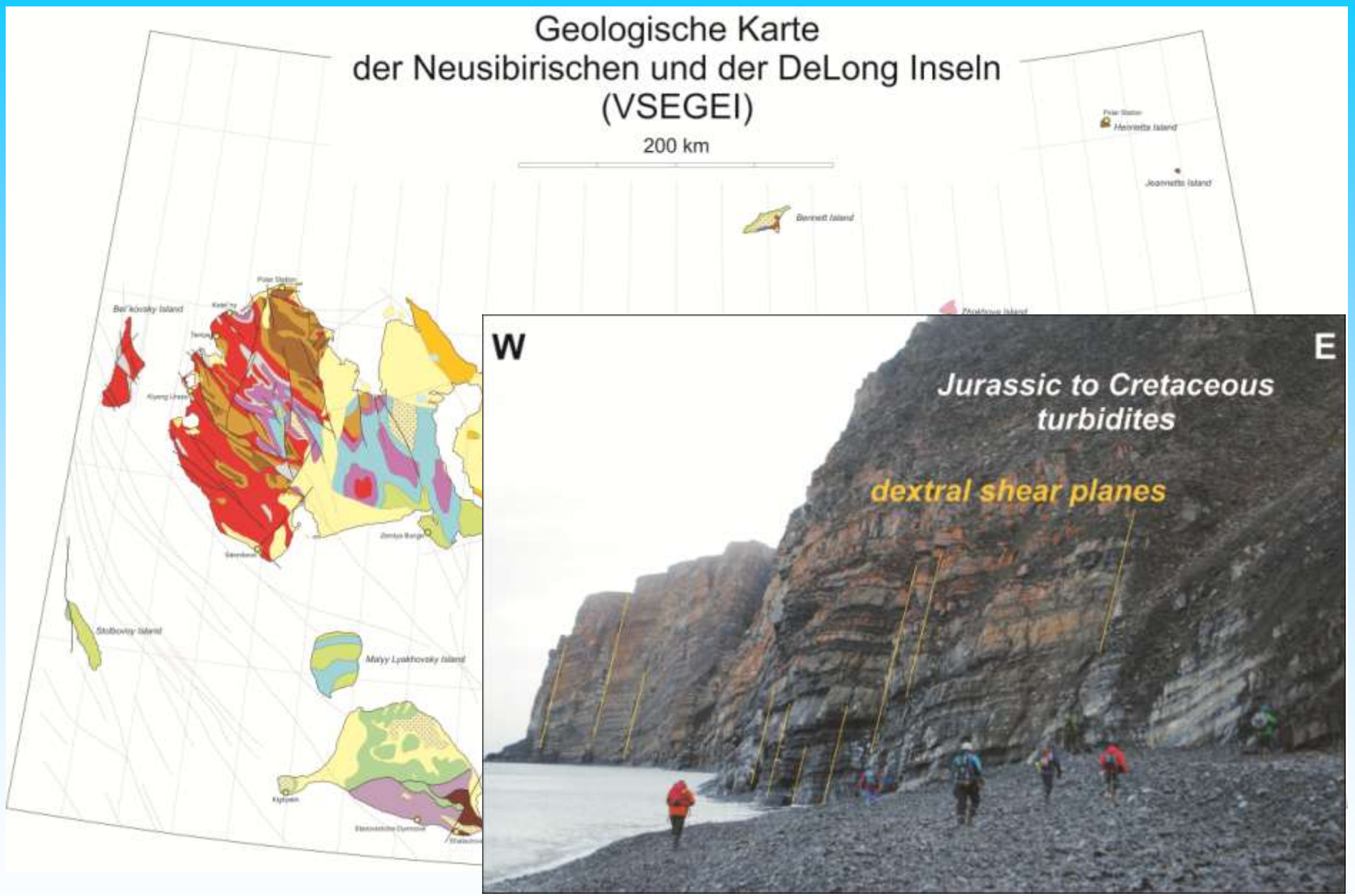
Geologische Karte der Neusibirischen und der DeLong Inseln (VSEGEI)



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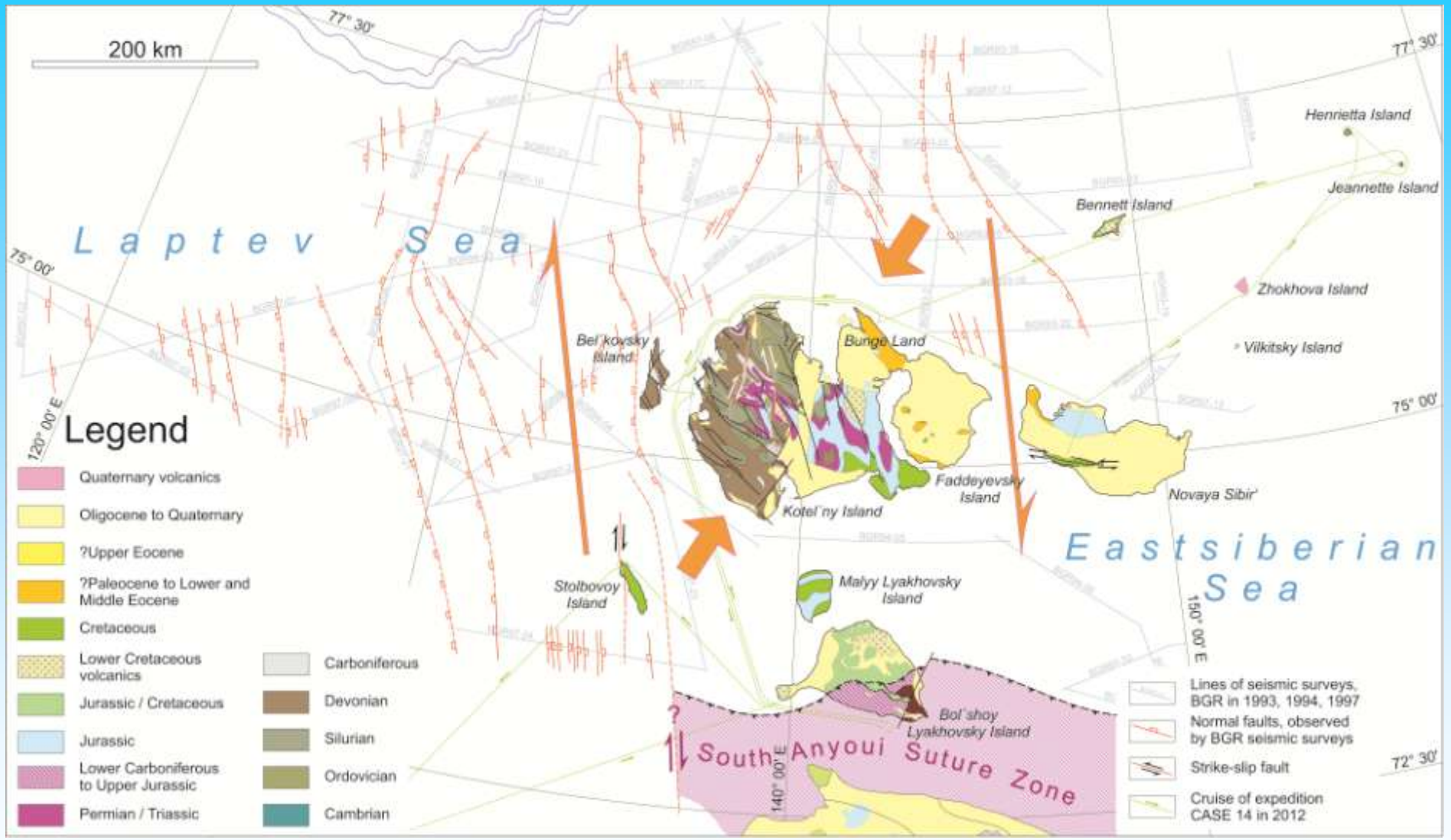

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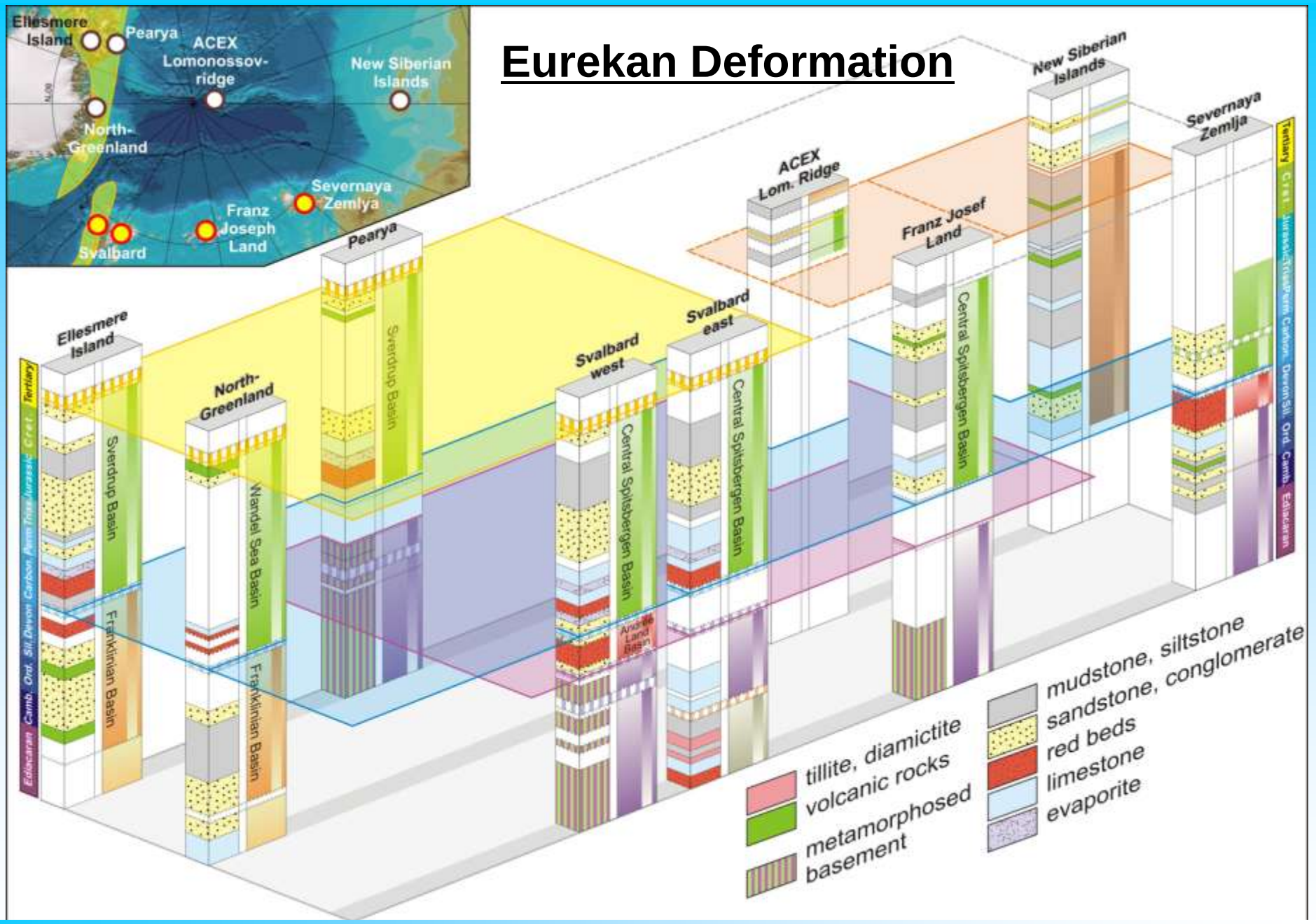
Eurekan Deformation



Eocene

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First stage

Eurekan Deformation

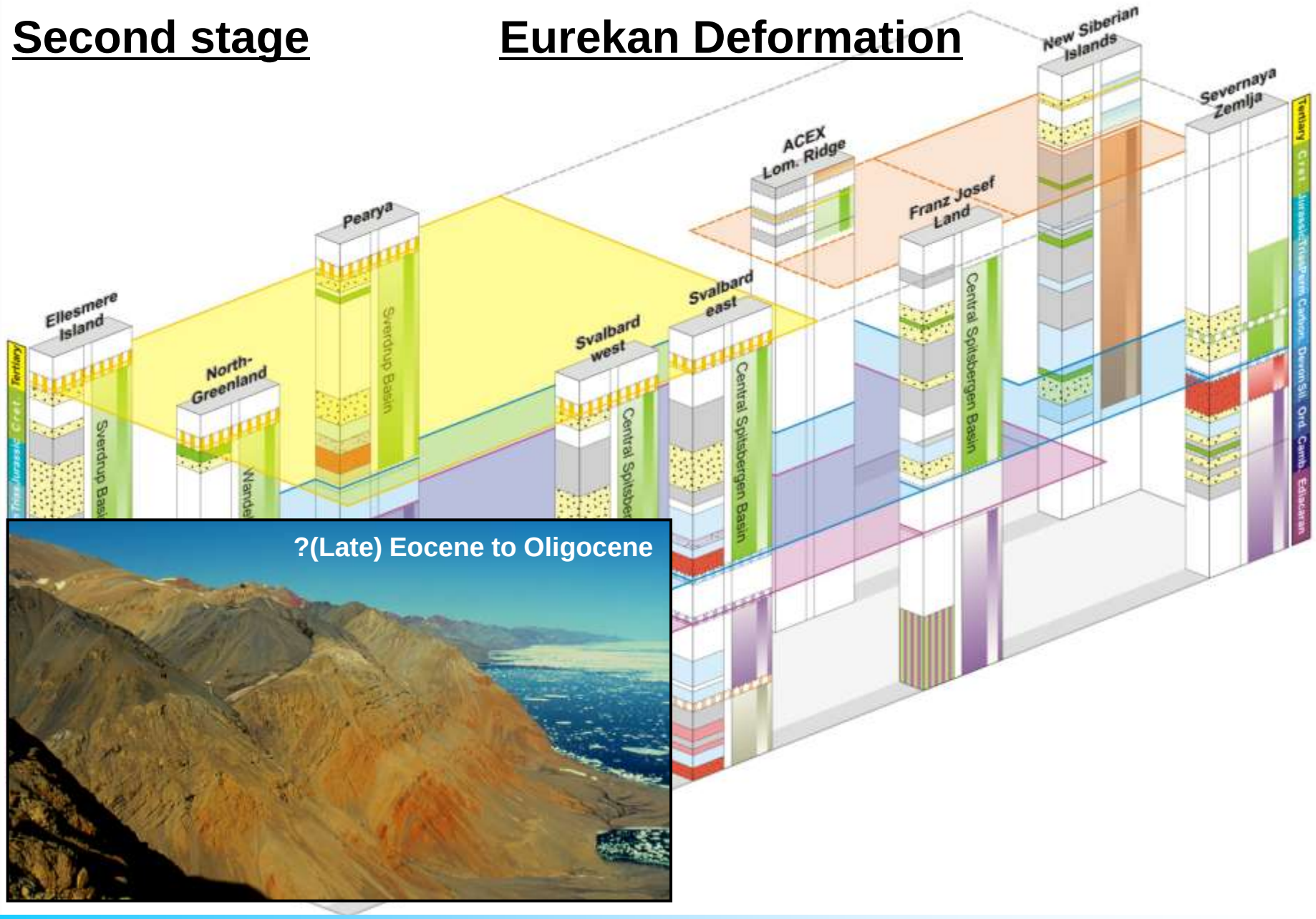
Eocene

Eurekan Deformation

Eocene

Second stage

Eurekan Deformation



Eocene

Eurekan Deformation

Eocene

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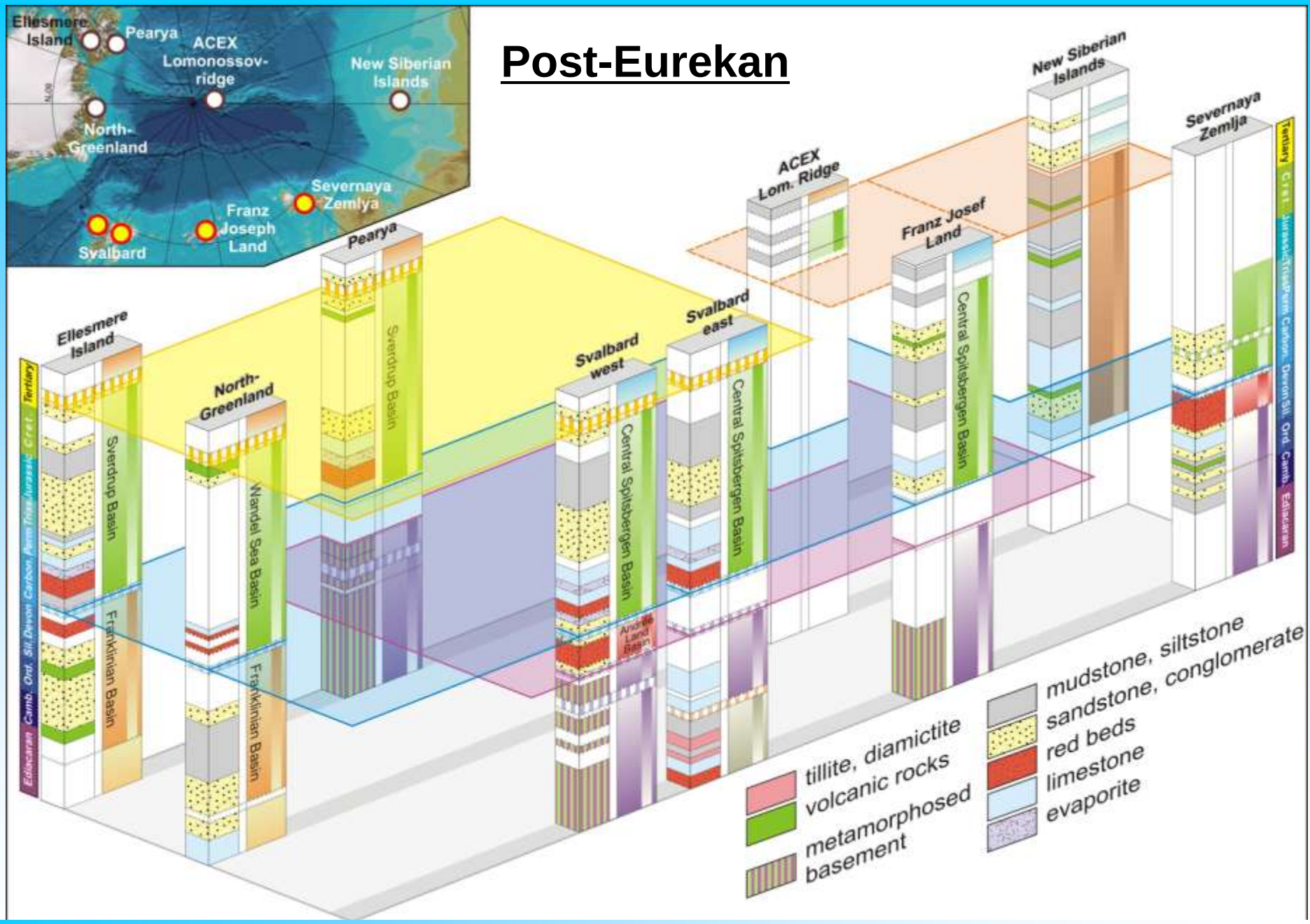

Oligocene to Recent

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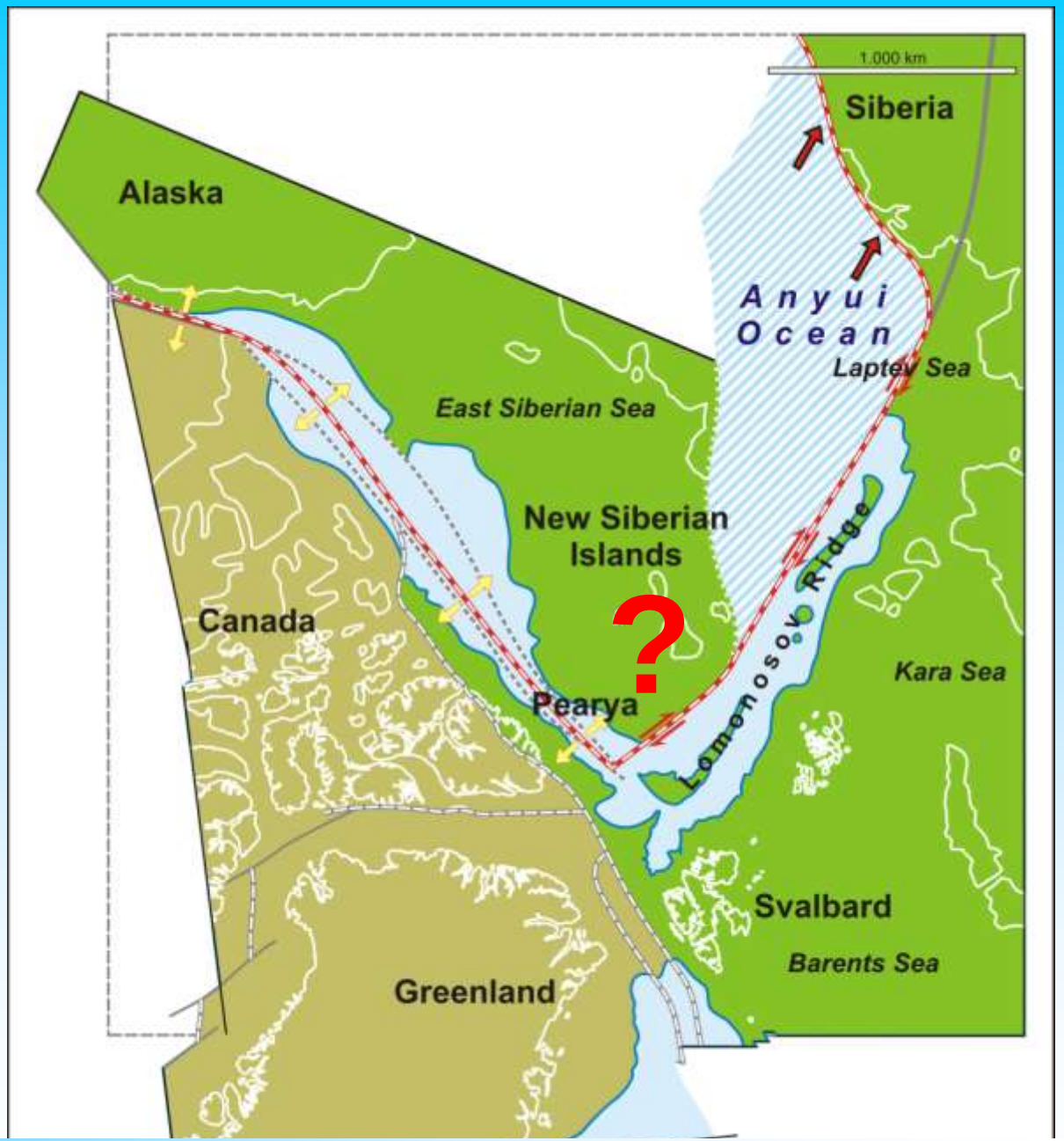
The relation of the NSI to the opening of the Arctic Ocean



Late Jurassic and Early Cretaceous

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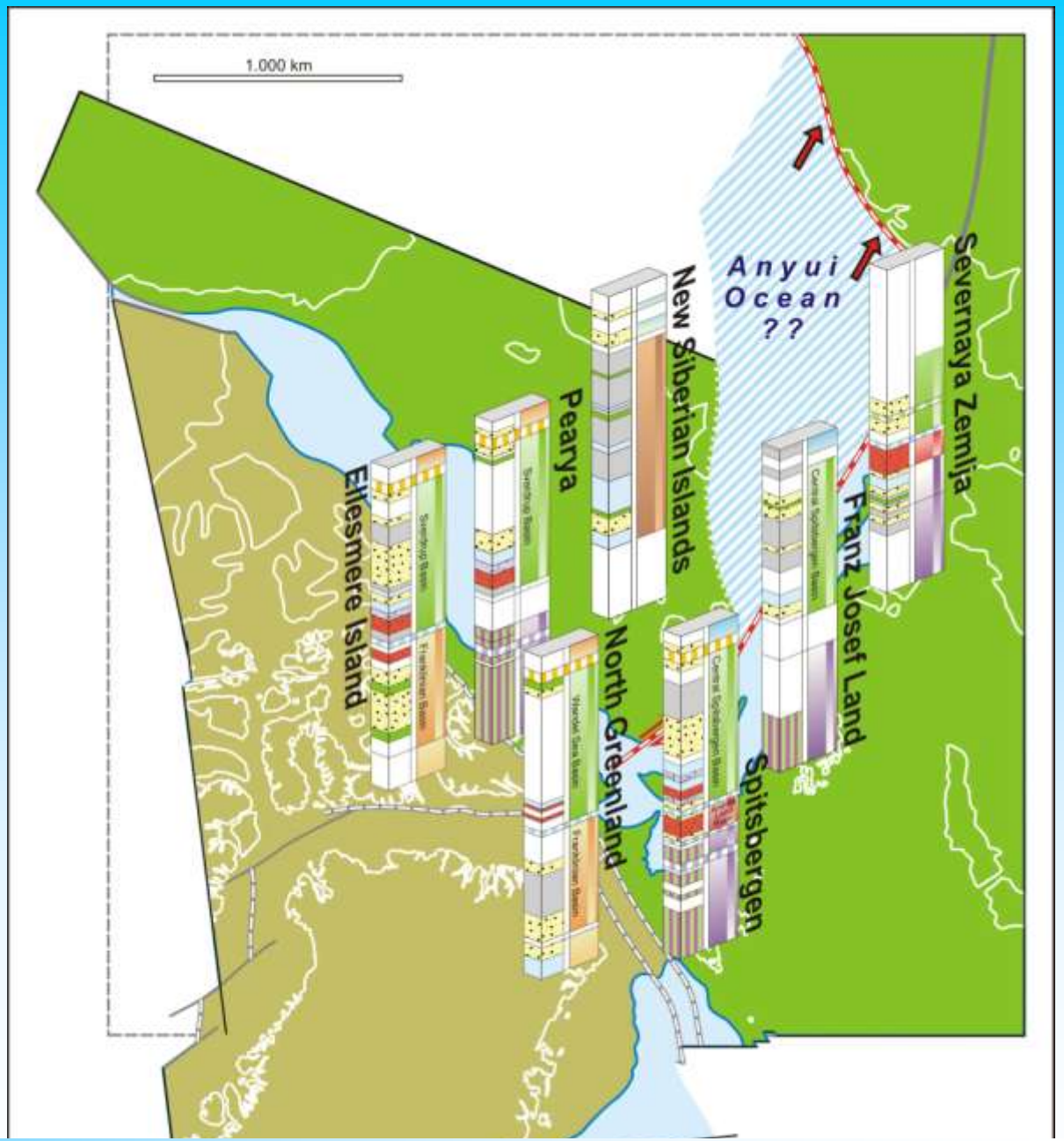
The relation of the NSI to the opening of the Arctic Ocean



Late Jurassic and Early Cretaceous

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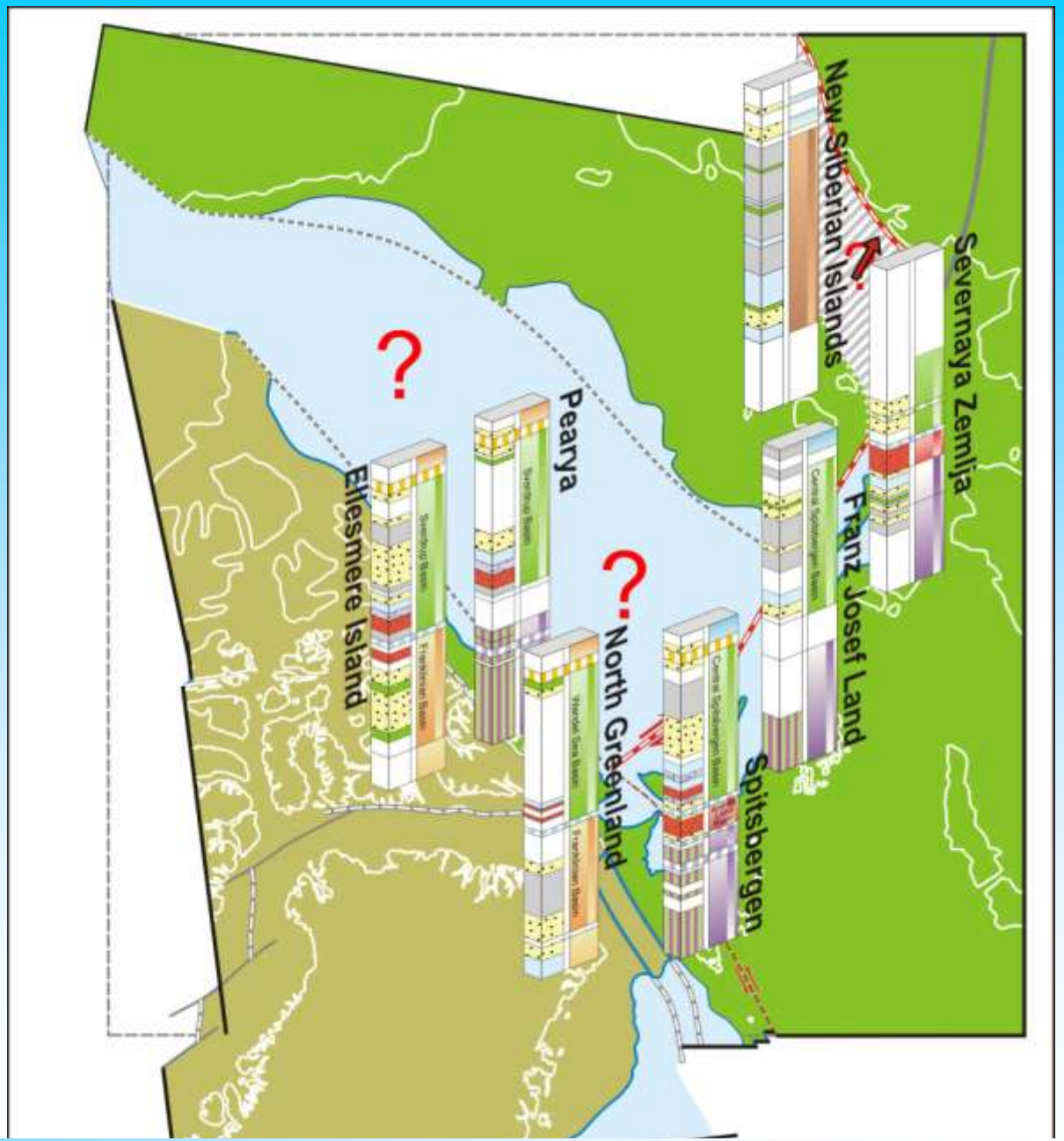

Late Jurassic and Early Cretaceous

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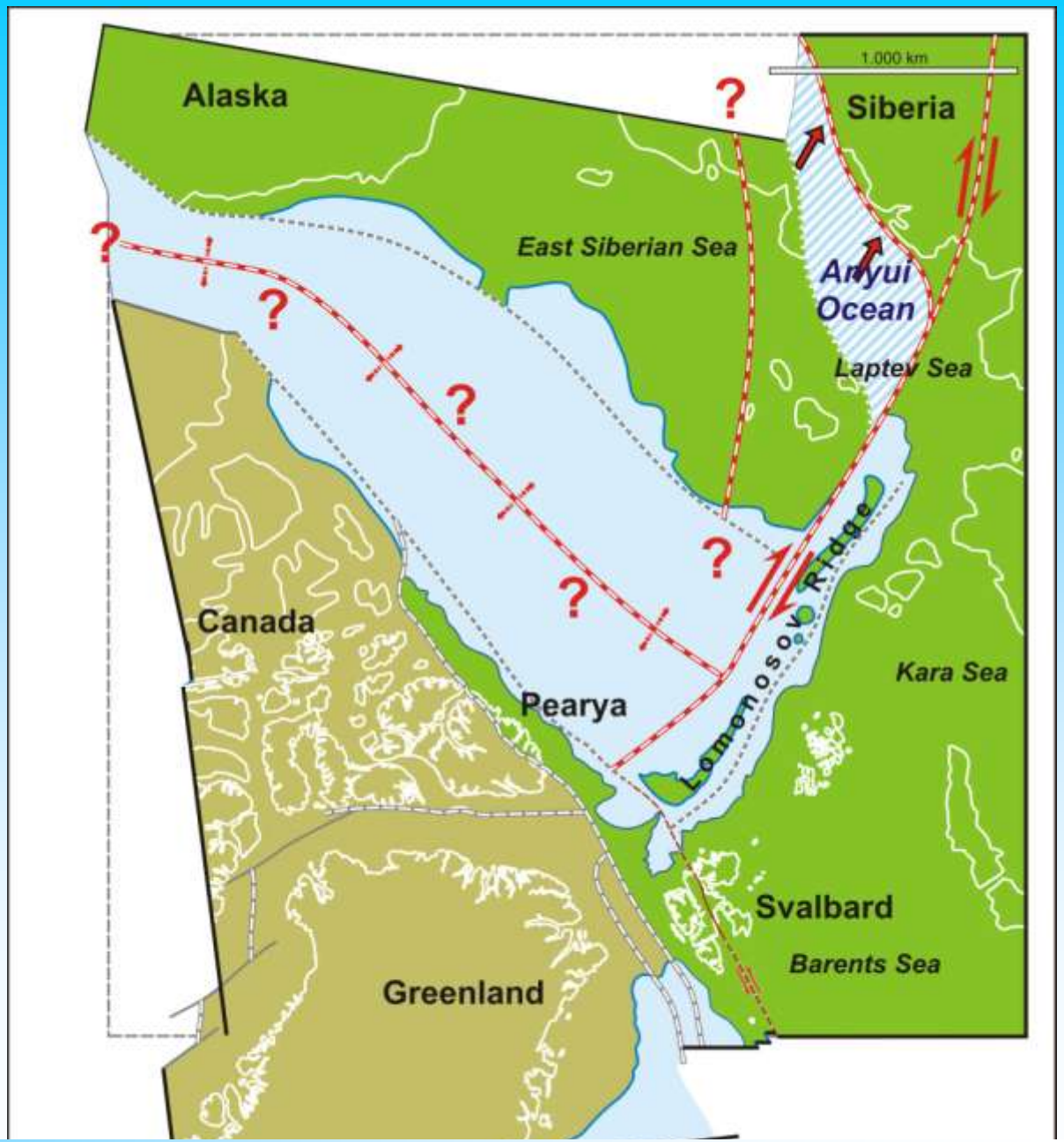
The relation of the NSI to the opening of the Arctic Ocean

Closure of the Anyui „Ocean“

Dextral motion along the later Laptev Sea Rift; Anyui deformation zone does not need to cross the fault to the west

?first movement between Lomonossov Ridge and Eurasia?



Pre-Aptian/Albian (120 Ma)

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The relation of the NSI to the opening of the Arctic Ocean

Anyui Suture Zone is inactive

Sea-floor spreading starts in the Eurasian Basin and Baffin Bay

Compression West Spitsbergen Fold-and Thrust Belt

Extension in the Laptev Sea Rift

Chron 24 (55 Ma): Eurekan stage 1

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The relation of the NSI to the opening of the Arctic Ocean

Transpression between Greenland and Ellesmere Island

Dextral strike-slip between Greenland and Svalbard

Extension in the Laptev Sea Rift

Chron 21 (49 Ma): Eurekan stage 2

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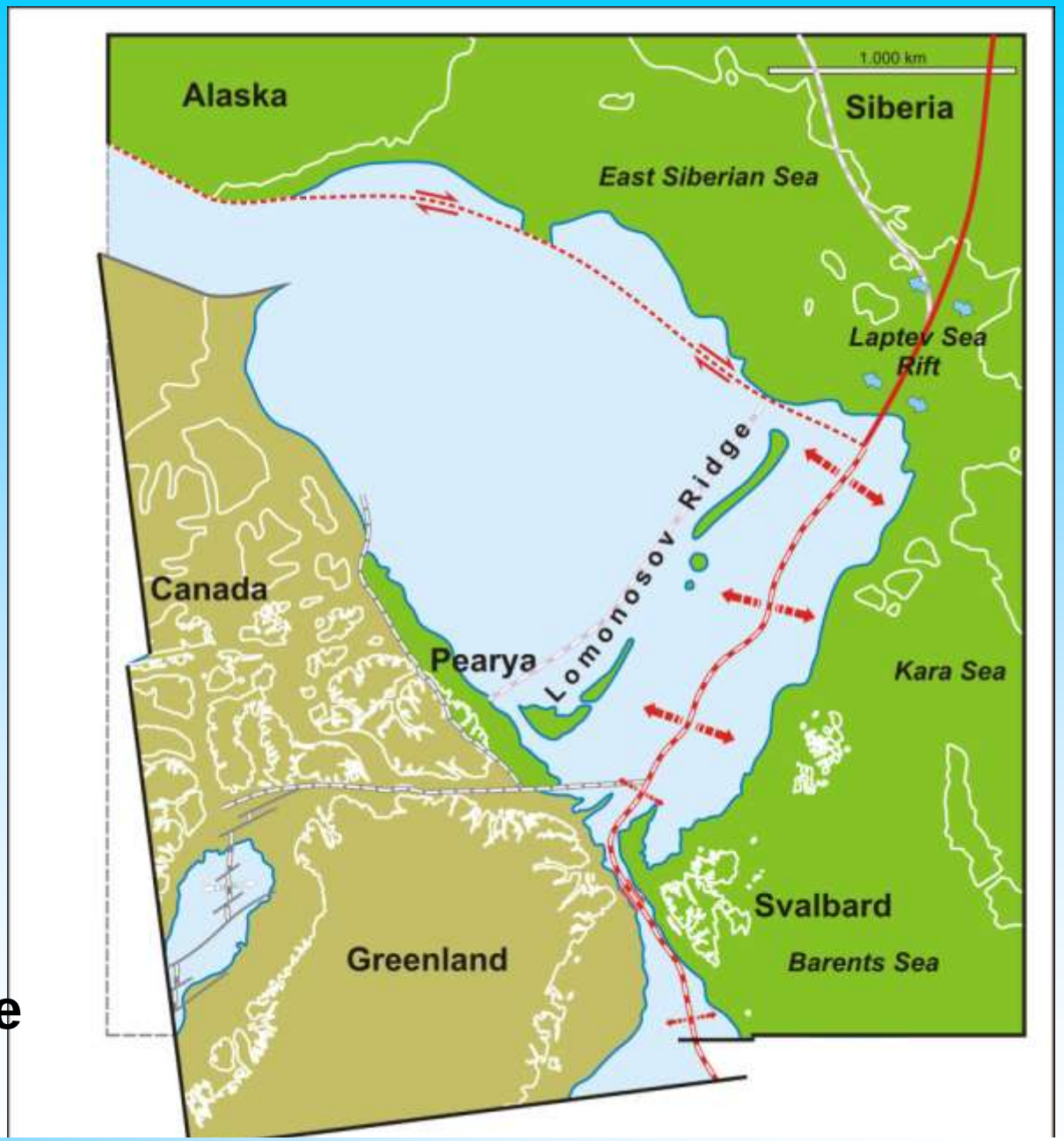
The relation of the NSI to the opening of the Arctic Ocean

Termination of sea-floor spreading in Baffin Bay

Dextral strike-slip between Greenland and Svalbard

Extension in the Laptev Sea Rift

Transition towards the Recent configuration



Chron 13 (35 Ma): post-Eurekan

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Thank you very much for your attention

….and a lot of thanks to, e.g., Higgins et al. (1991), Stemmerik & Haakansson (1991), Trettin (1991), Dallmann (1999), Lorenz et al. (2008), Kos‘ko & Korago (2009) etc…….