A short introduction to the geology around the inner part of the Oslo fjord.

The city of Oslo is located in a geologically interesting area in the middle of the Permian Oslo Graben surrounded by Precambrian basement. Within the city and around the Oslo fjord we find well exposed Permian igneous rocks and a down-faulted Lower Palaeozoic sequence preserved from erosion by the graben structure. The lower Palaeozoic marine shales and limestones form the low ground in the city centre and in Bærum and Asker to the SW while the Permian igneous rocks make up the high ground to the north and west. The landscape is also strongly influenced by glacial erosion and we find lakes dammed by terminal moraines to the north of the city. Even in the central part of the City there are many good geological exposures.
From the map (Fig 1,2) we can see that the outline of the Oslo rift and the distribution of the main rock types. The rift forms a half-graben with the main fault on the eastern side which is very prominent along the Nesodden Peninsula (Fig3)

The geology of the city of Oslo and its surrounding include a rather unique variety of rock types:

1) Precambrian basement rocks (900-1000 million years or older).
2) A Lower Palaeozoic marine sedimentary sequence from Middle Cambrian to late Silurian overlain by a late Silurian to lowermost Devonian sandstones deposited in a foreland Basin during Caledonian folding.
3) A relatively thin sequence of continental and partly also marine Late Carboniferous sediments unconformably overlying the folded Cambro-Silurian sediments.
4) Uppermost Carboniferous and Permian lavaes, intrusives and magmatic rocks.
5) Quaternary deposits deposited during and shortly after the retreat of the last glaciation including terminal moraines and glacial-marine sediments. The maximum marine level in Oslo after the ice retreated was 226 m.

The Lower Palaeozoic sequence starts with the Middle Cambrian transgression covering much of the Precambrian Baltic shield (Fig 3).
A shallow epicontinental sea existed on this stable craton until the late Silurian Caledonian Orogeny.
Land areas which could provide a source of clastic sediments on the Baltic Shield must have been rather small and the sequence was deposited during low sedimentation rates only a few meters per million years. The sediments are highly fossiliferous and of low metamorphic grade except where contact metamorphosed.
The Lower Palaeozoic sequence was divided into 9 stages by Kjerulf and Brøgger representing partly biostratigraphic, partly lithological units. Later more formal lithostratigraphic units (Fig 2) have been introduced (Worsley et al 1984, Owen et al 1990).
During the Upper Cambrian and the earliest Ordovician black organic rich mud was deposited when the bottom conditions were stagnant. The Alum shale was a good source rocks which matured during the Caledonian folding similar to other foreland type petroleum basins in the Middle East or east of the Rocky Mountains.

The Ordovician sequence consists of a very typical sequence of shales and limestones.
Much of the sequence consists of nodular limestones which are limestone concretions in a matrix of calcareous (marly) shales. The regular alterations of thin limestone beds and shales may represent regular orbital (Milancovitch) climatic variations.

Near the Ordovician/Silurian boundary there is a break in the sequence indicating a relative short period of uplift and exposure before the marine sedimentation continuous in the lower Silurian. Below the unconformity we find cross-bedded sand with ooids and quarts grains.
On the many islands in the inner parts of the Oslo fjord there are excellent exposures particularly of the Ordovician shales and limestones.
The Silurian sequence also includes nodular limestone but also more massive limestones, some with abundant corals. These sediments where deposited when the Oslo region was in a position close to the equator.
The contact between limestones deposited in a clear water environment with corals to the overlying siliceous mud and sand of the prograding foreland basin facies is very sharp.

The folded Lower Paleozoic sediments form ridges of alternating limestones and shales forming the shapes of the islands in the inner parts of the Oslo fjord.
The late Silurian (Caledonian) folding occurred when the sediments where soft and ductile and even the relatively thin limestones have been folded in tight folds during progressive burial during the deposition of the overlying late Silurian sandstones (Ringerike Fm).
The Oslo area was then a part of a large foreland basin in along the eastern margin of the Caledonian mountain chain (Fig 3) and was in a similar structural position as Iraq and other parts of the Middle East relative to the mountains in Iran. Large amounts of oil were generated from the Cambrian Alum shale during increasing burial in the foreland basin in the Oslo Region but almost none of this is preserved.
Sailing in the sounds between the islands we get very good cross sections illustrating the tectonic style of the Caledonian folding.
The Oslo rift is a part of the Carboniferous and Permian rift system which are found in the North Sea and Scotland. Just to the south of Oslo it is a half-graben and the main fault is on the eastern side along Nesodden which is a horst with Precambrian basement rocks.
The Permian lavaes form a prominent escarpment at Kolsås in Bærum and also further south in Asker. Below the lavaes the Upper Carboniferous sediments are forming the base of the cliffs (Fig 4).
This film will take you on a boat trip in the inner part of the Oslo fjord and also to localities in the surrounding area. The main emphasis will be on the lower Palaeozoic sequence which is almost complete from the Middle Cambrian to the late Silurian.
It is just a very small sample of the many interesting aspects of the geology in and around Oslo.
Some references on the sedimentology and the stratigraphy of the Lower Palaeozoic sediments of the Oslo area.

Bjørlykke, K. 1974. Depositional history and geochemical composition of lower Paleozoic epicontinental sediments from the Oslo Region, Norway. Norges Geologiske Undersøkelse Bull. 305, 81 pp.
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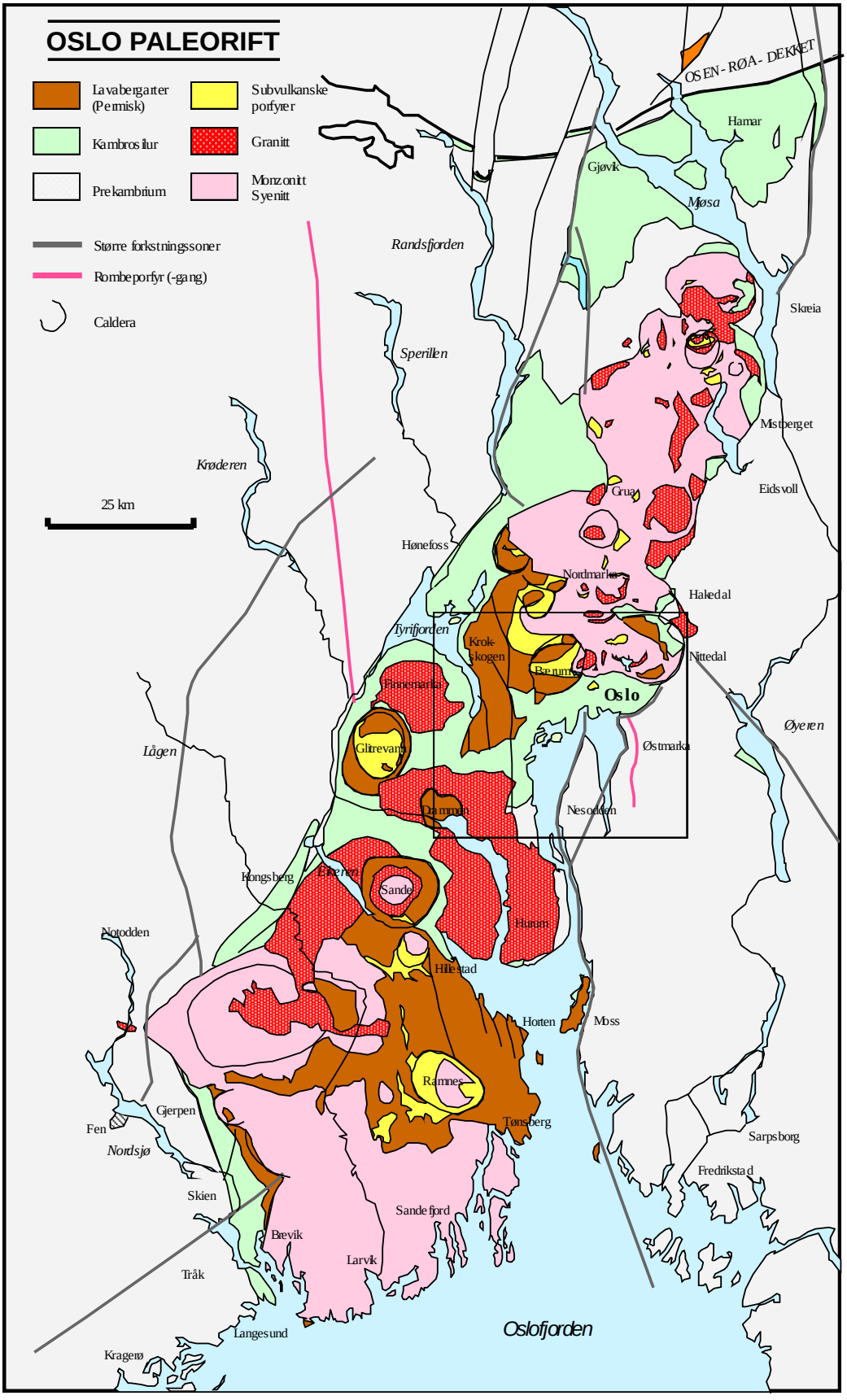
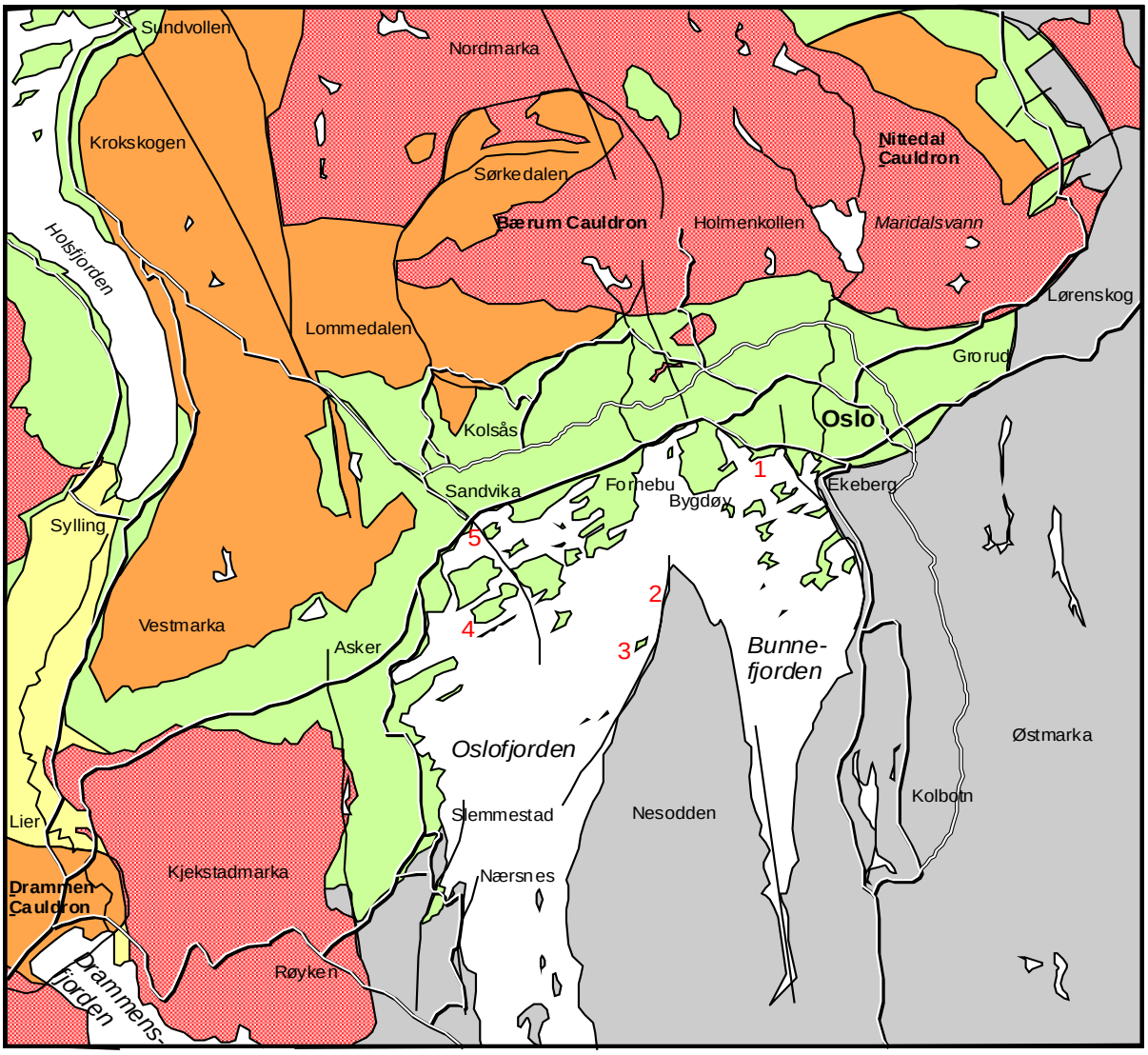
Owen,A.W.,Bruton,D.L., Bockelie, J.F. and Bockelie, T.1990. The Ordovician Succession of the Oslo Region. Norway. Norges Geologiske Undersøkelse Special Publication. No 4.1-54.

Worsley, D., Aarhus, N., Basset, M.G., Howe, M.P.A., Mørk,A. and Olaussen, S. 1983. The Silurian Succession of the Oslo Region. Norges. Geologiske. Undersøkelse. Bull 384.1-57.



O. Nilsen 2001, etter Ihlen & Vokes (1978); Pedersen, 1986 og Nordgulen (1999)

Fig 1.



Simplified geological map of the Oslo area

Permian plutonic rocks

Permian lava

L..Palaeozoic sediments

Precambrian basement

Quaternary sediments

Major faults

EKSKURSJONSLOKALITETER:
1 - Tjuvholmen
2 - Flaskebekk
3 - Ildjernet
4 - Spannlokket
5 - Kalvøya

Sammenstilt av Odd Nilsen, 1997, hovedsakelig etter Naterstad (1991)

Fig 2.

Simplified section across the Oslo Rift

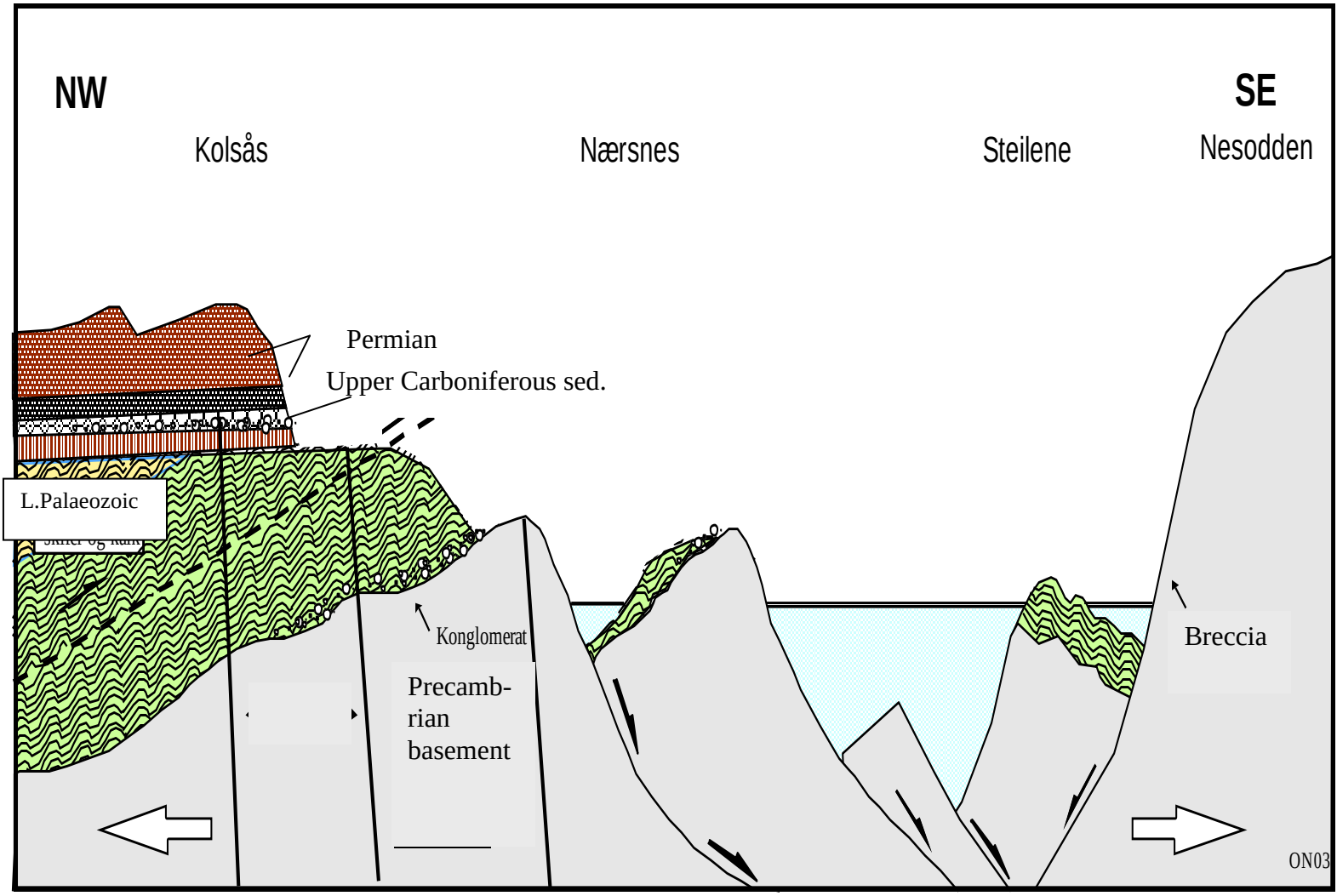


Fig 3.

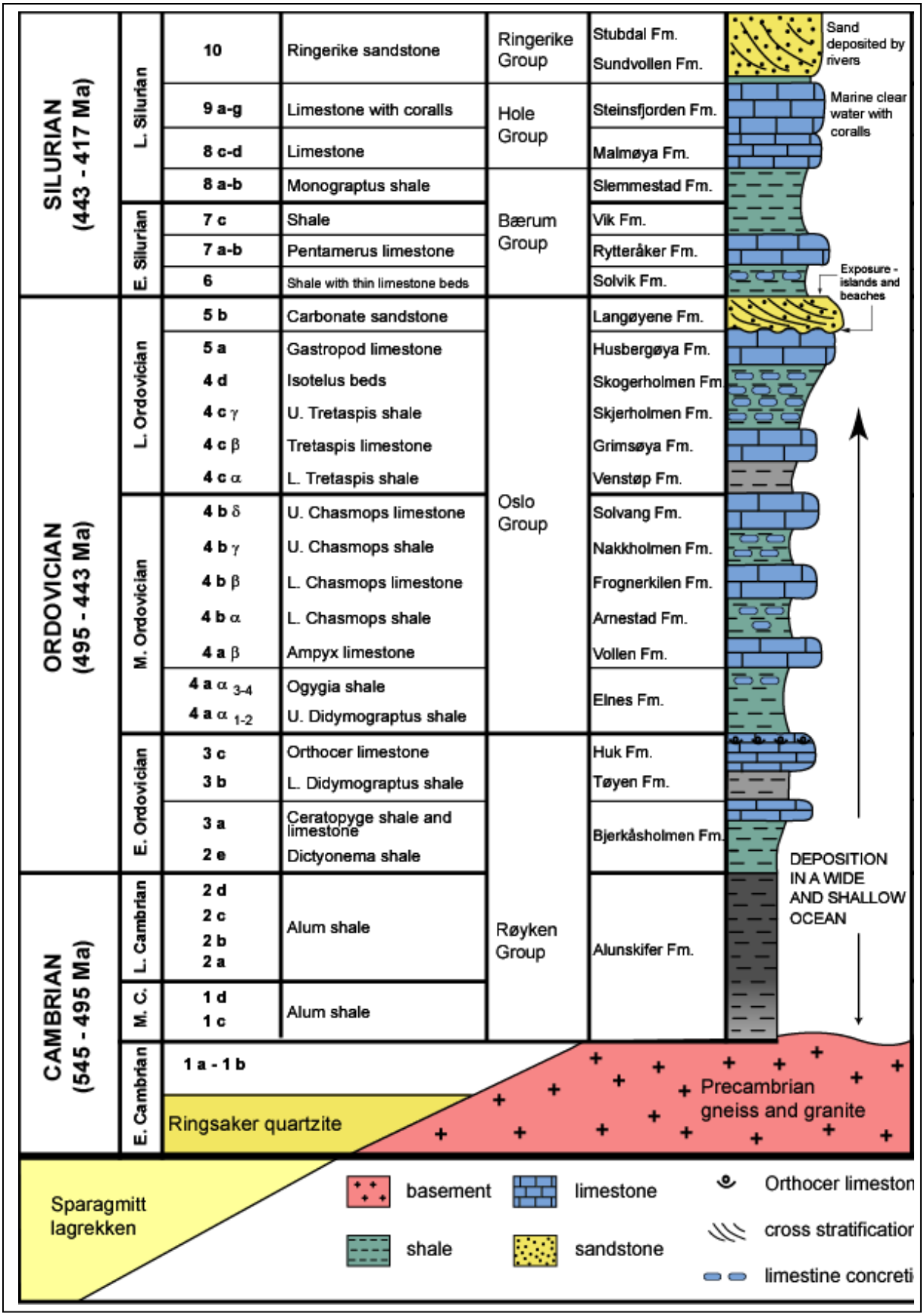


Fig 4 Stratigraphy of the Lower Palaeozoic of the Oslo Area.

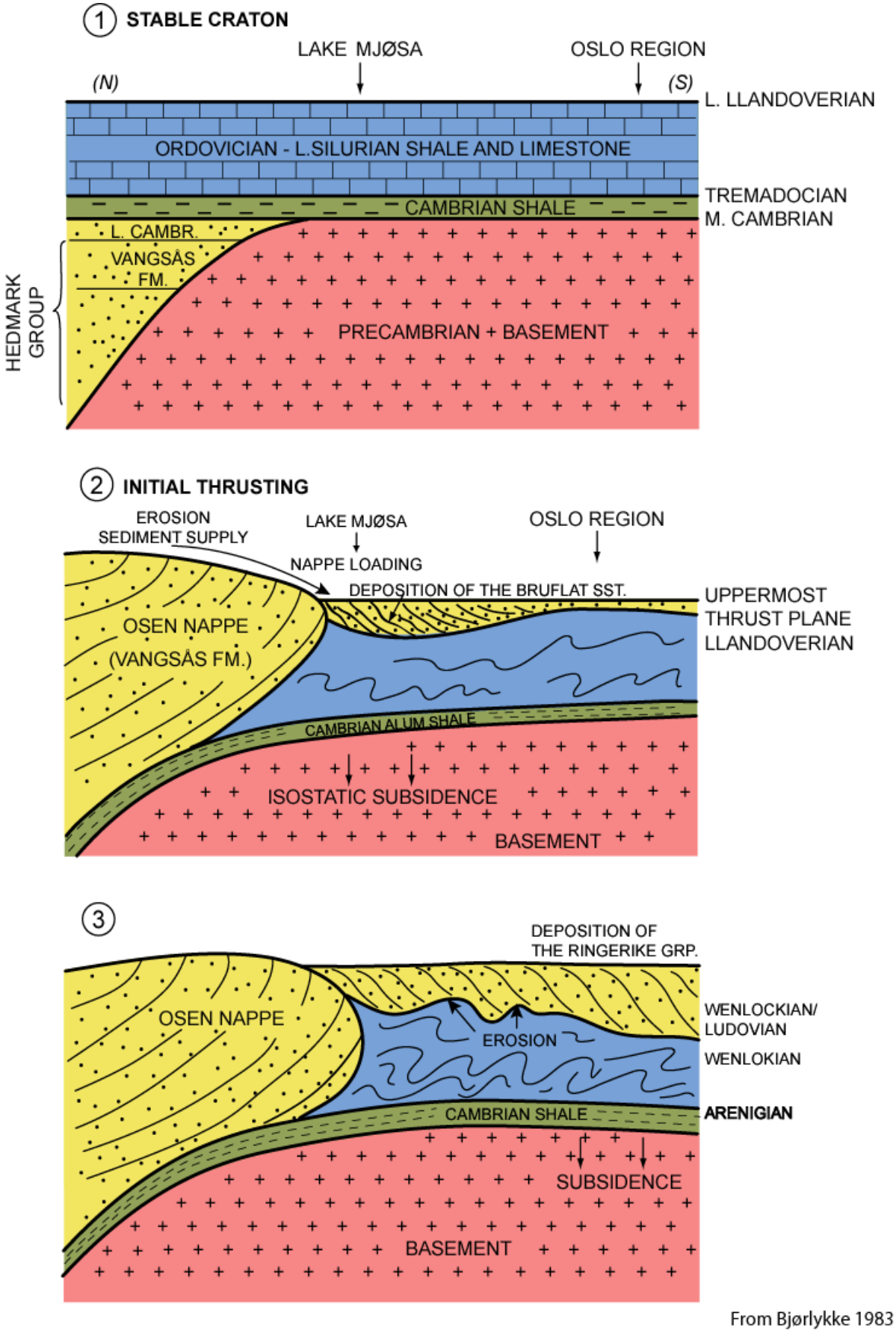


Fig 5 Simplified reconstruction of the tectonic evolution of a foreland basin in the Oslo Region