Nanaimo Group unconformity stop - Nanaimo Parkway, Nanaimo B.C.

Field trip stop: About 100m southwest of intersection of Jingle Pot Road and Nanaimo Parkway (note this is the southern of two places on the parkway where Jingle Pot Road crosses). Suggested parking at the cul-de-sac of King Road, southwest of the Jingle Pot Rd intersection.

Outcrop: main outcrop is on southwest side of highway, with Upper Cretaceous Nanaimo Group comprising the northwest third of the outcrop, The unconformity surface with the underlying Upper Triassic Karmutson Formation is well exposed at the base of the coarse conglomerate of the Nanaimo Group Comox Formation.

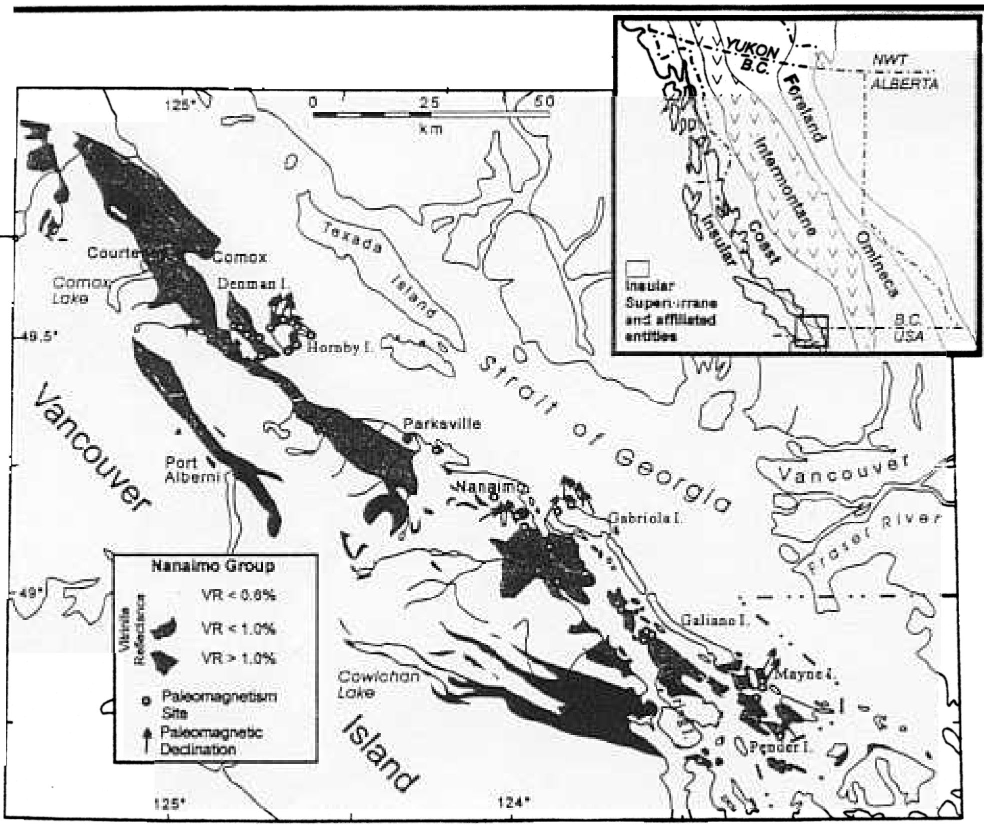


Fig. 1. Nanaimo Group major outcrop areas, showing thermal maturity and main sample sites of the Enkin et al., (2001) paleomagnetic study.

The Nanaimo Group is an Upper Cretaceous succession of siliciclastic sedimentary rocks preserved within and on the margins of the Strait of Georgia in southwest British Columbia, Canada (Fig. 1). The Nanaimo Group unconformably overlies Wrangellia Terrane on its west side, the Coast Belt on its east side, and is in inferred fault contact with the San Juan thrust system (part of the northwest Cascade terranes) to the south-east (Fig. 1). The Nanaimo basin was an elongate northwest-trending depocenter during Turonian to Maastrichtian time, although there is no constraint on its original extent to the west or north. Deposition was continuous at least from Santonian to late Maastrichtian ages, although both Turonian and Coniacian strata occur in the basal Nanaimo Group, indicating the basin began to form about 90 Ma. The basin accumulated a > 4 km thick succession, consisting of subaerial and marine siliciclastics, with the upper two-thirds of the succession represented mostly by a stacked repetition of submarine fan complexes. Currently, two models are frequently cited for the tectonic setting of this basin. England and Bustin (1998) suggest a broad-ridge forearc basin model for deposition. Mustard (1994), and Mustard et al., (1995) interpret deposition to have occurred within a peripheral foreland basin, in front of, and mostly derived from, a complex series of overlapping and cross-cutting thrust belts which formed in the Coast Belt and Northwest Cascades about 100 to 80 million years ago. The published strike-slip basin model of Pacht (1984) is no longer considered credible (discussed in detail in Mustard 1994). It was based on the interpretation that faults within and bordering the Nanaimo Group were in general strike-slip and in part synsedimentary, both interpretations discredited by more recent structural studies.

The Nanaimo Group succession has been the subject of great interest, especially over the past 10 years, as its position and age makes it integral to testing evidence of large scale translation of the western part of the Canadian Cordillera during the late Cretaceous, the "Baja B.C. Hypothesis". The Baja BC hypothesis, based on several paleomagnetic studies, suggests that the Insular Superterrane and related entities of the Canadian Cordillera were subject to >3000 km of northward displacement with respect to cratonic North America from ~90 to ~50 Ma (recently reviewed in Enkin et al. 2001).

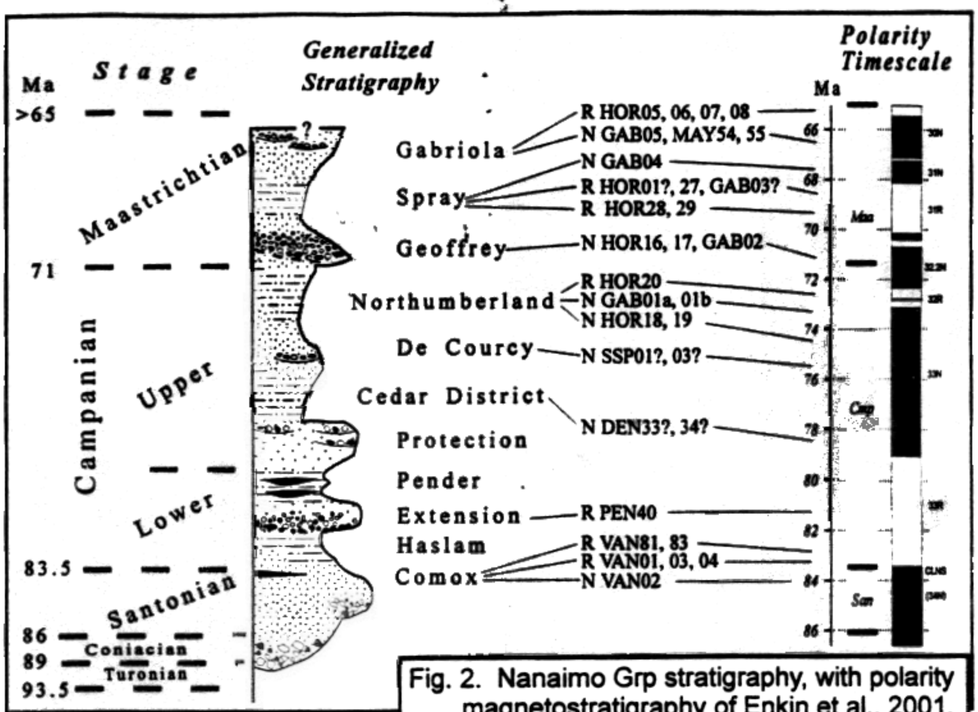


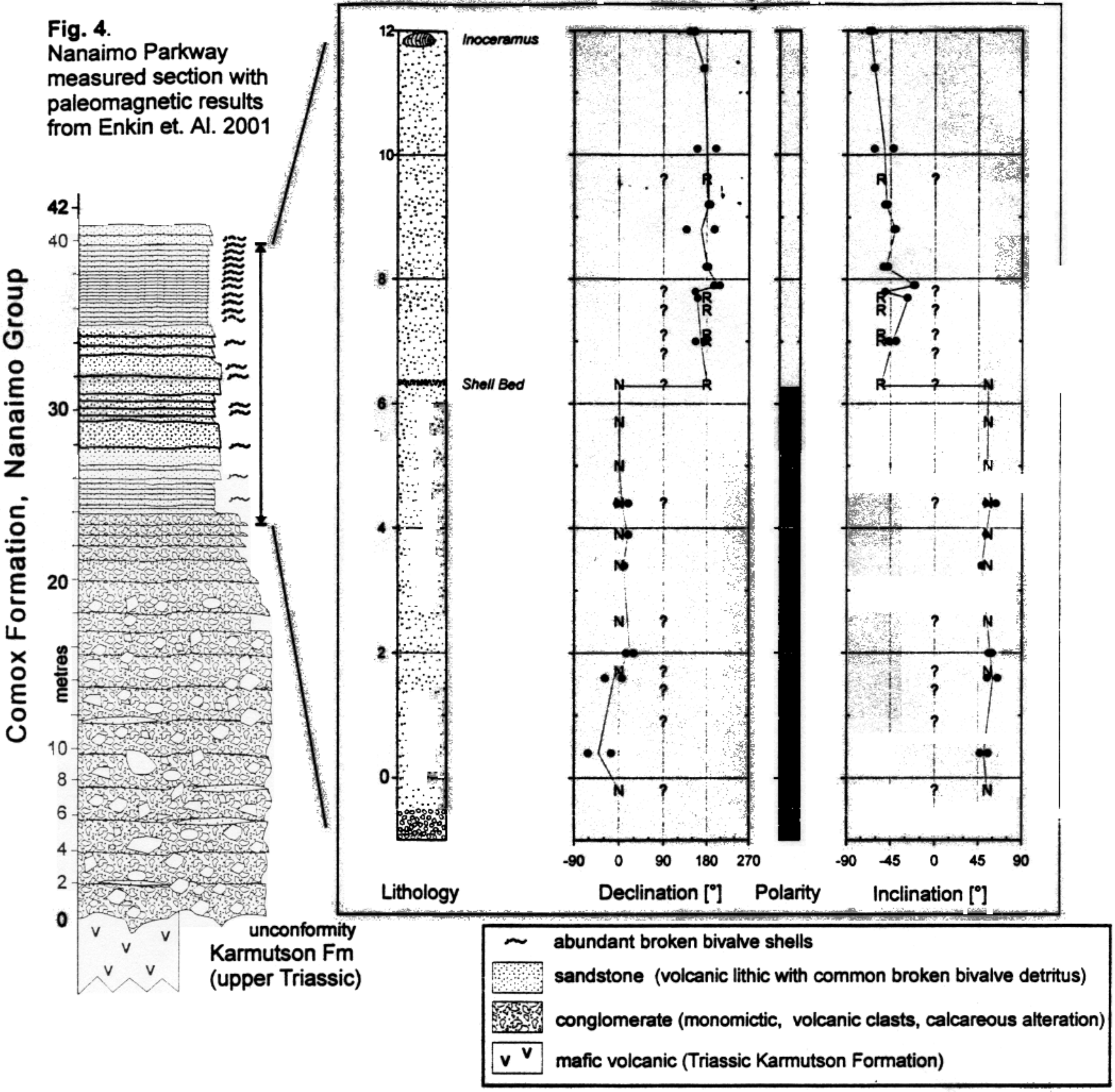
Fig. 2. Nanaimo Grp stratigraphy, with polarity magnetostratigraphy of Enkin et al., 2001.

Fig. 3. Published Nanaimo Group paleomagnetic solutions for paleolatitude, Pole for Nanaimo Group are from the Enkin et al., 2001 study only.

The Nanaimo Group has proven to be an important focus for study for several reasons. It was deposited directly on the "Baja B.C." entity, but on the west side of any possible major transpressive structures which could have been active during the Late Cretaceous, thus it should record the maximum displacement of any part of the entity. It was a continuously active depositional basin during the majority of the time of proposed major lateral translation, and thus should preserve evidence of significant and progressive northward translation during the 25+ million year evolution of the basin. Its' sedimentary nature also provides less controversial measures of paleohorizontal than available for volcanic or plutonic rocks. The Nanaimo Group is also well-preserved, not greatly deformed, and contains large areas which have not been thermally altered to the point where the paleomagnetic signature would reset. It contains a diverse, well-preserved assemblage of micro- and macrofossils (with some exceptions), thus providing good biostratigraphic control and key evidence for paleoclimate and paleolatitude and abundant paleocurrent and other provenance evidence, including an increasing amount of isotopic provenance data.

Two major paleomagnetic studies from Nanaimo Group rocks have been published (Fig.3). Ward et al. (1997) sampled from two formations in the northern part of the basin and interpreted the Nanaimo Group to have formed at 3500 ± 500 km south of present position (a paleolatitude south of present Baja Mexico). The much more extensive study of Enkin et al. (2001) sampled from all formations and from throughout the basin, including from the rocks of this field trip stop (Figs 2-4). In this study both polarities are observed, and reversals correlate well to paleontological data. The paleolatitude calculated from this study of 35.7°±2.6° (present day about the latitude of the Mexico-California border). which requires post Nanaimo Group northward displacement of 2300 ± 400 km. Significantly, both paleomagnetic studies show no evidence of a change in paleolatitudianl position during basin deposition, requiring any translation to be extremely rapid, probably restricted to Paleocene time (>15 cm / Ma for the lower amount of translation; >20cm / Ma for the higher result). In addition, the interpreted paleolatitudes continue to conflict with sedimentologic and paleontologic evidence that the Nanaimo Basin was deposited near its present northern position (e.g. Haggart, 2000, Kodama and Ward, 2001, Mahoney et al. 1999. Mustard. 2000).

Fig. 4.
Nanaimo Parkway measured section with paleomagnetic results from Enkin et. Al. 2001



The field trip stop is a fairly typical example of the lower Comox Formation, the basal part of the Nanaimo Group. Here the unconformity with the underlying Triassic Karmutsen Formation basalt is well exposed, though quite subtle due to the monolithologic nature of the overlying conglomerate, composed entirely of basaltic clastic material identical to the underlying rocks. The unconformity surface is typically sharp but irregular, with no preserved regolith. Local paleoscarps of a few metres to tens of metres are common and the unconfomity surface had an irregular paleorelief of several hundred metres maximum with low areas mostly intiially filled with poorly sorted conglomerates deposited in small alluvial fans or coastal talus. In most places the conglomerates contain rare to common thick-walled shell material, suggesting coastal environments of deposition (none have been found at this locality and it is likely nonmarine initially). The basal Comox Fm conglomerates are directly (though gradationally) overlain by shallow marine sandstone, here of a relatively high energy shoreface environment. Elsewhere, esturine, barrier bar and other marginal marine deposits are common, with deposits of lagoonal environments including extensive coal in the Comox Formation in the northern part of the Nanaimo Basin (Cumberland-Comox areas). With a few exceptions (most notably here in the Nanaimo area), the Nanaimo Group above the Comox Formation formed under deeper marine conditions, dominated by deep shelf and slope submarine fan deposits which make up all of the upper 2/3 of the Nanaimo Group strata.

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