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**Title of article** Deformational Styles in a Sequence of Olistostromal  
Melanges, Pacific Rim Complex, Western Vancouver Island, Canada

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see Bulletin v. 101, p. 1520 - 1542

**Contents**

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## TO BE PLACED IN THE GSA DATA REPOSITORY

### APPENDIX

#### FOSSILS FROM THE PACIFIC RIM COMPLEX

This compilation includes all the information presently available for fossil localities in the Pacific Rim Complex. Fossils identified by paleontologists of the Geological Survey of Canada (GSC) have been assigned GSC locality number; the collections and associated reports for these localities are archived with the GSC. Radiolaria from ribbon chert collected by J. E. Muller were identified by E. A. Pessagno, Jr. of the University of Texas at Dallas and are part of Pessagno's research collection. Radiolaria collected by Brandon were identified by both Pessagno and E. S. Carter (on contract to the GSC). Carter's report and collections are archived with the GSC. The radiolarian residues that Carter identified had already been picked and identified by Pessagno; as a result, some rare taxa may be missing and account for age discrepancies between Pessagno and Carter.

#### UCLUTH FORMATION

##### LOCALITY NO. U1

Field No. 811016-1A of Brandon

GSC loc. C-102729

811013-6 of Brandon

C-102727

**Location:** Collected from limestone in the Ucluth Formation on the northwest side of the Ucluth Peninsula. 48° 57.70'N, 125° 36.05'W.

The sample comes from a calcrudite consisting of clast-supported cobbles of gray limestone in a darker limestone matrix. Crinoid fragments are present in the cobbles and may also be in the matrix. The calcrudite is clearly interbedded with volcanic breccia and tuff.

Age: Late Triassic, late Early Norian.

Conodonts were recovered and identified by M. Orchard (GSC). The diagnostic fauna are as follows:

811016-1A (C-102729):

Epigondolella abneptis subspecies B of Orchard (1983): late Early Norian

811013-6 (C-102727):

Epigondolella abneptis Huckriede: Early Norian

#### LOCALITY NO. U2

Field No. 82922-5A of Brandon

GSC Loc. C-102721

82922-5B of Brandon

C-102722

Location: Collected from a gray limestone bed in Ucluth Formation from the west side of Ucluth Peninsula. 48° 57.05'N, 125° 35.23'W.

This limestone is clearly interbedded with the volcanic rocks. It contains thin interbeds of green tuff and black cherty sediment, and is intruded by a small diorite dike. Macrofossils include small ammonoids, and fragments of gastropods and crinoids.

Age: Late Triassic, Carnian.

Conodonts from 82922-5A (C-102721) were identified by Orchard (GSC). The diagnostic fauna is Parapolygnathus polygnathiformis (Budoror and Stefanor): Carnian.

Ammonoids were identified by E.T. Tozer (GSC) as probably Late Triassic. His faunal descriptions are as follows (GSC report no. TR-5-1985- ETT):

82922-5A (C-102721):

Traskites? sp., cf. "Shastites" compressus Hyatt and Smith, probably a new species. Evidently the same species as recorded from the Karmutsen Group of Texada Island (see J.E. Muller and D.J.T. Carson, GSC Paper 68-50, p. 13). Age: Probably Upper Triassic. Precise dating uncertain because the ammonoids are imperfectly preserved and probably new.

82922-5B (C-102722):

Globose ammonoid in section. Age: Probably Upper Triassic.

#### LOCALITY NO. U3

Field No. 82814-2A of Brandon

GSC loc. C-127529

**Location:** Collected from ribbon chert interbedded with pillow lava and tuff breccia, at the west end of beach at Ahous Bay, Vargas Island. 49° 10.85'N, 126° 00.57'W.

The volcanic rocks at Ahous Bay have been grouped with the Ucluth Formation, although pillow lava and ribbon chert are not typical of the Ucluth elsewhere. This decision is supported by the fact that the Ahous Bay rocks are similar to Ucluth in that they consist predominantly of fragmental andesitic

volcanic rocks. They are also closely associated with demonstrable Ucluth Formation exposed to the northwest of Ahous Bay. The lithologic differences between the Lower Jurassic Ahous Bay rocks and the Upper Triassic volcanic rocks of the Ucluth unit is attributed to temporal changes in stratigraphy.

**Age:** Early Jurassic, middle or late Toarcian, or possibly earliest Middle Jurassic, Aalenian (see Carter's report for discussion). Radiolaria were identified by Pessagno (writ. comm., 1983) and by Carter (GSC).

Pessagno's report is as follows:

Zone 01, upper half of Subzone 01B. Lower Jurassic: upper Toarcian

Zartus jurassicus Pessagno and Blome  
Zartus dickinsoni Pessagno and Blome  
Canoptum sp. (abundant)  
Canoptum sp. aff. C. anulatum Pessagno and Poisson  
Lupherium sp. cf. L. officerense Pessagno and Whalen  
Napora sp.  
Paronaella sp.  
etc.

Carter's report is as follows (GSC report no. 1-1985-ESC, C-127529):

Ares ? sp.  
Canoptum sp. aff. C. anulatum Pessagno and Poisson  
Canoptum sp.  
Emiluvia ? sp. D (in Carter, 1985)  
Eucyrtid gen. and sp. indet.  
Gigi sp.  
Hsuum sp.  
Lupherium sp. cf. L. officerense Pessagno and Whalen  
Lupherium ? sp. C (in Carter, 1985)  
Lupherium spp.  
Mesosaturnalis sp.  
Paronaella sp.  
Perispyridium ? sp. (in Carter, 1985)  
Praeconocaryomma sp. aff. P. immodica Pessagno and Poisson  
Pseudocrucella sp.  
Napora sp. aff. N. bukryi Pessagno (in Carter, 1985)  
N. bona Pessagno, Whalen and Yeh

N. browni Pessagno, Whalen and Yeh  
N. turgida Pessagno, Whalen and Yeh  
Stichocapsa sp. aff. S. Japonica Yao  
Tritrabs sp.  
Turanta morinae Pessagno and Blome  
T. nodosa Pessagno and Blome  
Xitus ? sp. B (in Carter, 1985)  
Zartus dickinsoni Pessagno and Blome  
Z. Jurassicus Pessagno and Blome

Age and correlation: Early Jurassic, possibly earliest Middle Jurassic: middle to late Toarcian, possibly Aalenian. Zone 01, subzone 01B (upper part) to Zone 1A, subzone 1A<sub>2</sub>, possible subzone 1A<sub>1</sub> sensu Pessagno and others (1986).

A number of species included on the above list do not appear before the middle Toarcian, i.e. Perispyridium ? sp., Turanta morinae, Zartus dickinsoni, Lupherium ? sp. C., Napora sp. aff. N. bukryi Pessagno, and Xitus ? sp. B. According to Pessagno and others (1986), Canoptum s.s. does not occur above the upper Toarcian; however, as the Aalenian is not well documented, it is possible that Canoptum could range somewhat higher. Several species of Napora are found in this assemblage which, according to Pessagno, Whalen and Yeh (1986) are Aalenian in age, so far as is known.

Correlative with the Whiteaves and Phantom Creek Fms. of Cameron and Tipper (1985), Queen Charlotte Islands; also with the Hyde Fm. and the Warm Springs Member of the Snowshoe Fm., eastern Oregon.

Carter's comment on Pessagno's report:

All taxa listed by Pessagno have again been recorded and are included on the above species list. Age is essentially the same. Pessagno states assemblage is from "Zone 01, upper half of subzone 01B". To clarify this seeming discrepancy: in 1983 the boundary between Zone 01 and Superzone 1 was placed at the Toarcian/Aalenian boundary. Based on new data from the Queen Charlotte Islands and east-central Oregon, this boundary is now placed in the middle Toarcian (Pessagno and others, 1987); the upper half of subzone 01B now equates to Zone 1A/Subzone 1A<sub>2</sub> = upper Toarcian.

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UPPER JURASSIC PILLOW BASALT BLOCKS IN MÉLANGE

LOCALITY NO. JP1

Field No. 72-27G of Muller

Pessagno's loc. VAI-1A to -1F

(see Muller and others, 1981)

**Location:** Red radiolarian ribbon chert from a block in mudstone-matrix mélange. Located about 5 km southeast of Ucluelet, on coast opposite Food Islets. 48° 55.12'N, 125° 28.92'W (location in Muller and others, 1981 incorrect). This locality was not confidently relocated by me, but I strongly suspect that it corresponds to the chert-basalt block that I sampled for chemical analysis (GJP2 in Brandon, 1989), which indicates an ocean-floor-type chemistry for the basalts.

Six samples were collected at this locality by Muller and Pessagno, and were designated VAI-1A through VAI-1F by Pessagno who processed and identified the radiolaria (Pessagno, written comm., ca. 1976).

**Age:** Late Jurassic, late Kimmeridgian: Zone 2 sensu Pessagno, Blome and Longoria (1984). The diagnostic taxa are: Hsuum maxwelli Pessagno, which is no younger than Zone 3 (Pessagno, Blome and Longoria, 1984), H. cuestaensis Pessagno, which is no older than Zone 2 (Pessagno, Blome and Longoria, 1984), and Praeconocaryomma magnimamma (Rust), which according to Pessagno (1977a) is restricted to Zone 2 sensu Pessagno, Blome and Longoria (1984).

Pessagno's (ca. 1976) report to Muller is given below. It provides a composite list of taxa for all 6 samples. Note that what is now considered to be "late Kimmeridgian" was called "upper Kimmeridgian/lower Tithonian" in his

report. This change is due to improved understanding in the location of the Kimmeridgian/Tithonian boundary in the international timescale (see Pessagno, Blome and Longoria, 1984).

Subzone 2A, probably lower part [sensu Pessagno, 1977a]; Upper Jurassic: upper Kimmeridgian/lower Tithonian [= upper Kimmeridgian sensu Pessagno, Blome and Longoria, 1984].

Eucyrtidium(?) ptyctum Riedel and Sanfilippo  
Praeconocaryomma mamillaria (Rust)  
Praeconocaryomma magnimamma (Rust)  
Hsuum maxwelli Pessagno  
Hsuum cuestaensis Pessagno  
Hsuum obispoensis Pessagno  
Pantanellium riedeli Pessagno  
Archeodictyomitra rigida Pessagno  
Parvicingula turrita (Rust)  
Paronaella sp.  
Spongocapsula palmerae Pessagno  
Parvicingula sp.  
Emiluvia sp.  
Emiluvia salensis Pessagno  
Crucella sanfilippoae Pessagno

#### LOCALITY NO. JP2

Field no. 75-25A of Muller

Pessagno's loc. VAI-2A to -2C

(Muller, unpublished data)

**Location:** Radiolarian ribbon chert from block of pillow basalt in mudstone-matrix mélange; chert is clearly in depositional contact with the pillow basalt. Collected along coast on the southeast side of Ucluelet Inlet, at the southeast corner of Indian Reservation no. 5. 48° 55.38'N, 125° 30.21'W. An analysis of pillow basalt from this block (sample GJP8 in Brandon, 1989) indicates ocean-floor type chemistry.



**Age:** Late Jurassic, late Kimmeridgian to late Tithonian: Zone 2 to Zone 4 sensu Pessagno, Blome and Longoria (1984). The diagnostic taxon is Praeconocaryomma mamillaria (Rust), which according to Pessagno (1977a) is restricted to Zone 2 to Zone 4 sensu Pessagno, Blome and Longoria (1984). Parvicingula spp. is Middle Jurassic (Aalenian) or younger (Pessagno, Blome and Longoria, 1984).

Pessagno's (ca. 1976) report to Muller is given below. See comments about the Kimmeridgian/Tithonian boundary discussed under locality JP1.

Zone 2 to Zone 4 [sensu Pessagno, 1977a]; upper Kimmeridgian/lower Tithonian [= upper Kimmeridgian sensu Pessagno, Blome and Longoria, 1984] to upper Tithonian.

VAI-2A and 2C:

Poorly preserved; indeterminate

VAI-2B:

Praeconocaryomma mamillaria (Rust)  
Parvicingula sp.  
Archeodictyomitra rigida Pessagno

#### LOCALITY NO. JP3

Pessagno's loc. VAI-3 (Muller, unpublished data)

**Location:** Radiolarian chert from large pillow basalt block in mudstone-matrix mélange; ribbon chert is clearly in depositional contact with pillow basalts. Collected by Muller and Pessagno along coast on the southwest side of Francis Island near the small, battery-powered beacon. 48° 55.33'N, 125°

31.22'W. An analysis of pillow basalt from this block (sample GJP7 in Brandon, 1989) indicates ocean-floor type chemistry.

Age: Middle Jurassic (Aalenian) to Late Jurassic (early Tithonian): Zone 1 to Zone 3 sensu Pessagno, Blome and Longoria (1984). Diagnostic taxa are:

Parvicingula spp., which is Middle Jurassic, Aalenian, and younger (Pessagno, Blome and Longoria, 1984), and Hsuum maxwelli, which is no younger than Zone 3 (Pessagno, Blome and Longoria, 1984). If the identification of Parvicingula procera Pessagno is correct, then the age is restricted to late Kimmeridgian to early Tithonian, because according to Pessagno (1977a) P. procera is no older than Zone 2 sensu Pessagno, Blome and Longoria (1984).

Pessagno's (ca. 1976) report to Muller is given below. See comments about the Kimmeridgian/Tithonian boundary discussed under locality JP1.

Zone 1 to Zone 4 [sensu Pessagno, 1977a]: upper Kimmeridgian/lower Tithonian [= upper Kimmeridgian sensu Pessagno, Blome and Longoria, 1984] to upper Tithonian.

Hsuum maxwelli  
Parvicingula turrita (Rust)  
Parvicingula sp.  
Emiluvia sp.  
Archeodictyomitra ridida Pessagno  
Podobursa sp.  
Pantanellium riedeli Pessagno  
Spongocapsula palmerae Pessagno  
Paranaella sp. (Fragment)  
Parvicingula procera Pessagno?

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FOSSILS FROM MATRIX OF UNIT 1A MÉLANGE

LOCALITY NO. MA1

Field no. 82819-3A of Brandon

GSC loc. C-127531

**Location:** Collected from ribbon chert in Unit 1A at the south end of Wya Point. 48° 58.25'N, 125° 36.68'W. Sample comes from a lens of gray-green ribbon chert, about 30 cm thick, interbedded in mudstone matrix of the mélange (the prominent chert lens in Figure 9).

**Age:** Early Cretaceous, Late Valanginian to late Aptian. Radiolaria were identified by Pessagno (writ. comm., 1983) and by Carter (GSC). The minor discrepancy between Carter and Pessagno (Carter suggests that the age may be as young as Cenomanian) is due to the difficulty of identifying a rare specimen of Thanarla in Carter's sample. I have concluded that Pessagno's more restricted age determination is probably correct, because he was first to pick and identify the radiolarian from this sample, and therefore had the benefit of a greater number Thanarla individuals to assist his identification.

Pessagno's report is as follows:

Zone 5, Subzone 5C to Zone 6 [sensu Pessagno, 1977b]. Lower Cretaceous: upper Valanginian to upper Aptian.

Thanarla conica (Aliev)  
Holocryptocanium sp. (abundant)  
Archeodictyomitra sp.

Carter's report is as follows (GSC report no. 1-1985-ESC):

Amphipyndax ? sp.  
Archeodictyomitra sp. cf. A. vulgaris Pessagno  
Archeodictyomitra sp.  
Eucyrtid gen. and sp. indet.  
Holocryptocanium sp. (abundant)  
Parvicingula spp.  
Praeconocaryomma sp.  
Thanarla broweri (Tan Sin Hok) or T. conica (Aliev)  
Vitorfus ? sp.

### Xitid

Age and Correlation: Early Cretaceous: Late Valanginian to late Aptian, possibly Albian to Cenomanian.

This is rather an indistinctive assemblage and difficult to assign an age to. Part of the problem centers on the identification of a single poorly preserved specimen of Thanarla which could be either T. conica (Aliev), restricted to late Valanginian to late Aptian (subzone 5C to Zone 6 sensu Pessagno 1977b), or T. broweri (Tan Sin Hok) which can range higher to the Albian or possibly Cenomanian. Pessagno found only T. conica in this sample which lends weight to the former identification with a more restricted range.

Archeodictyomitra vulgaris Pessagno ranges from the latest Valanginian to late Aptian? (Pessagno, 1977b); however, Nakaseko and Nishimura (1981) have found it higher in an assemblage from the Shimanto Group in Japan of approximately Albian to Cenomanian age. While the specimens in this sample have a few more costae (which are more narrowly spaced), they do resemble A. vulgaris.

Two other indistinct (partial/flattened) forms which may support a younger age are Vitorfus ? sp., Albian to latest Campanian so far as is known, and Amphipyndax ? sp., a genus which to my knowledge does not occur much below the Albian.

In general, this assemblage contains many forms similar to the Holocryptocanium barbui -- H. geysersensis Assemblage of Nakaseko and Nishimura (1981) from the Shimanto Group of Japan. However, the abundant Holocryptocanium in this sample cannot, with confidence, be assigned to either of these species.

Correlative also with the Budden Canyon Fm. (Murphy and others, 1964) of the California Coast Range.

LOCALITY NO. MA2

Field no. 82919-2A of Brandon

GSC loc. C-127530

**Location:** Collected from ribbon chert in Unit 1A at the central part of Wya Point. 48° 58.35'N, 125° 36.82'W. This chert forms a lens, about 75 cm thick and 12 m long, interbedded in the black mudstone matrix of the mélange.

**Age:** Early Cretaceous, probably Late Valanginian or Hauterivian (see Carter's report for discussion). Radiolaria were identified by Pessagno (writ. comm., 1983) and by Carter (GSC).

Pessagno's report is as follows:

Indeterminate. Abundance of Holocryptocanium suggests correlation to other samples cited above.

Holocryptocanium sp. (fragmental and abundant)

Carter's report is as follows (GSC report no. 1-1985-ESC):

Archeodictyomitra sp. cf. A. vulgaris Pessagno

Archeodictyomitra sp.

Diacanthocapsa sp. aff. D. ovoidea Dumitrica

Eucyrtid gen. and sp. indet.

Holocryptocanium sp. (abundant)

Parvicingula cosmoconica (Foreman)

Parvicingula sp.

**Age and Correlation:** Early Cretaceous: probably Late Valanginian to Hauterivian.

This assemblage appears very similar to No. 82819-3A above; however, the range of Parvicingula cosmoconica (Foreman) as presently known, Berriasian--Hauterivian (Baumgartner, 1984), would indicate this assemblage is no younger than Hauterivian. Correlation same as above [locality MA1].

**LOCALITY NO. MA3**

Field no. 82810-4A of Brandon

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82810-4B of Brandon

GSC loc. C-127534

**Location:** Collected from ribbon chert sequence on the south side of Blunden Island, west of Vargas Island.  $48^{\circ} 10.80'N$ ,  $126^{\circ} 03.33'W$ . Sample -4B was collected about 1 meter above -4A in the same chert sequence. This chert comes from a *mélange* matrix composed of disrupted mudstone and chert, which surrounds small blocks of volcanic rocks. This assemblage is probably equivalent to the Unit 1A *mélange*. The rest of Blunden Island is composed of massive sandstone belonging to Unit 2.

**Age:** Early Cretaceous, Late Valanginian to late Aptian. Radiolaria were identified by Pessagno (writ. comm., 1983) and by Carter (GSC). The minor discrepancy between Carter and Pessagno (Carter suggests that the age may be as young as Cenomanian) is due to uncertainties in the identification of Thanarla (see discussion under locality no. MA1). Once again, I have concluded that Pessagno's more restricted age determination is probably correct, because he was first to pick and identify the radiolarian from these samples. Furthermore, Carter's identification was restricted to only one (-4B) of the two samples collected from this locality.

Pessagno's report for samples 82810-4A and -4B is as follows:

Zone 5, Subzone 5C to Zone 6 [sensu Pessagno, 1977b]. Lower Cretaceous: upper Valanginian to upper Aptian.

Thanarla conica (Aliev)

Holocryptocanium sp. (fragmental and abundant)

Cenosphaera sp.

Archeodictyomitra sp.

Carter's report for 82810-4B (GSC loc. C-127534) is as follows (GSC report no. 1-1985-ESC):

Archeodictyomitra sp. aff. A. simplex Pessagno  
Archeodictyomitra sp.  
Cenosphaera sp.  
Eucyrtid gen. and sp. indet.  
Holocryptocanium sp. (abundant)  
Mita sp.  
Parvicingula sp.  
Pseudodictyomitra sp.  
Thanarla broweri (Tan Sin Hok) or T. conica (Aliev)

Age and Correlation: Early Cretaceous: late Valanginian to Aptian, possibly Albian to Cenomanian.

This assemblage is generally similar to No. 82819-3A in that it contains the same species of Holocryptocanium and Thanarla, as well as the same eucyrtid. Once again, age may hinge on the range of Thanarla, which if T. conica (Aliev) is late Valanginian to late Aptian, and if T. broweri (Tan Sin Hok) may range higher to the Albian or Cenomanian. A single specimen with affinities to Archeodictyomitra simplex Pessagno somewhat supports the younger age (A. simplex Pessagno ranges from early Albian into the Late Cretaceous (Pessagno, 1977b, p. 23) so far as is known). Pessagno identified Thanarla conica, Holocryptocanium sp., Cenosphaera and Archeodictyomitra sp. in this sample. His "upper Valanginian to upper Aptian" age is based on the range of T. conica.

Correlation same as above two samples [locality nos. MA1 and MA2].

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FOSSILS FROM MATRIX OF UNIT 1B MÉLANGE

LOCALITY NO. MB1

Field no. 821011-3A of Brandon

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821011-3B of Brandon

GSC loc. C-127532

**Location.** Collected from sandy ribbon chert sequence from Unit 1B, located south of Big Beach (see Figure 13). 48° 55.87'N, 125° 33.00W. The chert sequence depositional overlies black mudstone and is in turn overlain by massive turbidite sandstone across a contact that is probably depositional. The lowest meter of the chert sequence consists of sandy radiolarian ribbon chert. The younging direction of the section is not known.

Sample -3A was collected just above the basal contact; -3B was collected about 75 cm above the contact.

**Age:** Early Cretaceous, Late Valanginian or early Hauterivian (see Carter's report for discussion). Radiolaria were identified by Pessagno (writ. comm., 1983) and by Carter (GSC). Pessagno picked and identified both -3A and -3B; Carter's looked at remaining material from sample -3B.

Pessagno's report for 821011-3A and -3B is as follows:

Zone 5, subzone 5C [sensu Pessagno, 1977b]. Lower Cretaceous: upper Valanginian to lower Hauterivian.

821011-3A:

Thanarla conica (Aliev)

Archeodictyomitra sp.

Ristola sp.

Mirifusus sp. (fragment)

Holocryptocanium sp. (very abundant and fragmental)

Cenosphaera sp.



821011-3B:

Thanarla conica (Aliev)  
Pseudodictyomitra sp.  
Holocryptocanium sp. (abundant and fragmental)

Carter's report for 821011-3B (C-127532) is as follows (GSC report no. 1-1985-ESC):

?Acaeniotyle diaphorogona Foreman  
Archeodictyomitra rigida Pessagno  
Archeodictyomitra spp.  
Cenosphaera sp.  
Eucyrtids gen. and sp. indet.  
Holocryptocanium sp.  
Parvicingula sp.  
Praeconocaryomma sp.  
Pseudodictyomitra sp.

Age and Correlation: Lower Cretaceous: probably Valanginian. Based strictly on my examination of this sample, I would suggest the age is latest Jurassic to early Cretaceous: late Kimmeridgian/early Tithonian to Berriasian or Valanginian -- this is determined by the age of Archeodictyomitra rigida Pessagno which ranges from the "late Kimmeridgian/early Tithonian to Berriasian or younger (Pessagno 1977a)". A single poorly preserved specimen could be Acaeniotyle diaphorogona Foreman, which ranges from late Callovian to Hauterivian. It has stout spines, however, shorter than the diameter of the shell, which according to Baumgartner (1984) may be more representative of Jurassic forms. Holocryptocanium in this sample is different from those in Nos. 82819-3A, 82919-2A and 82810-4B suggesting, along with the above evidence, that this sample is likely older than the previous three mentioned.

Pessagno identified Thanarla conica (Aliev), a form which again ranges from upper Valanginian to upper Aptian; he places the age as upper Valanginian to lower Hauterivian; the lower range determined by T. conica. Age then must be Valanginian (probably upper) but all other evidence suggests it is certainly not much younger.

A Jurassic age would correlate with the Alamo Creek succession (Stanley Mountain remnant of Coast Range ophiolite; found also at San Juan Islands (Trump Island), Baja California Sur (see Pessagno, Blome and Longoria, 1984), Point Sal, Santa Barbara

County, California and Blake Bahama Basin (DSDP Site 534).  
Correlation similar to above three samples for Lower Cretaceous  
age.

LOCALITY NO. MB2

Field no. 821011-1 of Brandon

GSC loc. C-127533

Location: Collected from ribbon chert in Unit 1B, south of Big Beach (see Figure 13).  $48^{\circ} 55.87'N$ ,  $125^{\circ} 33.00'W$ . This locality is within 10 meters of 821011-3A and -3B, described above, and would be expected to be of the same age. The chert comes from a small eroded block of sandy ribbon chert, about 30 m thick, surrounded by massive turbidite sandstone. One of the ribbon beds in the chert is actually a cherty sandstone.

Age: Late Jurassic, late Tithonian, to Early Cretaceous, Late Valanginian or early Hauterivian. Radiolaria were identified by Pessagno (writ. comm., 1983) and by Carter (GSC).

Pessagno's report is as follows:

Possibly Zone 4 to Zone 5, Subzone 5C [sensu Pessagno, Blome and Longoria, 1984, and Pessagno, 1977b]. Upper Jurassic (upper Tithonian sensu Pessagno, Blome, and Longoria, in press) to Lower Cretaceous (upper Valanginian to lower Hauterivian).

Ristola sp.aff. R. boesii (Parona)  
Acanthocircus dicranocanthos Squinabol?

Carter's report is as follows (GSC report no. 1-1985-ESC):

Acanthocircus dicranocanthos (Squinabol)  
Archeodictyomitra apaira (Rust)  
A. rigida Pessagno  
Cenosphaera sp.

Eucyrtidium sp.  
?"Hsuum" stanleyense Pessagno  
Milax sp.  
Parvicingula spp.  
Pseudodictyomitra sp.  
Ristola hsui ? Pessagno  
Ristola sp. aff. P. boesii (Parona)  
Sethocapsa ? sp.  
Spongocapsa sp.  
Stichocapsa naradaniensis Matsuoka  
Thanarla sp.  
Tricolocapsa sp. aff. T. plicarum Yao

Age and Correlation: Late Jurassic to Early Cretaceous: late Kimmeridgian/early Tithonian to Berriasian or possibly Valanginian. Significant taxa occurring in this assemblage include Acanthocircus dicranocanthos (Squinabol), Archeodictyomitra rigida Pessagno, Ristola sp. aff. P. boesii (Parona), Stichocapsa naradaniensis Matsuoka, plus two poorly preserved specimens questionably identified as "Hsuum" stanleyense Pessagno and Ristola hsui Pessagno.

In the radiolarian zonal schemes of Baumgartner (1984) and Pessagno, Blome and Longoria (1984), confusion still surrounds the Kimmeridgian/Tithonian boundary. For example: Acanthocircus dicranocanthos (Squinabol), recognized as a reliable marker taxon in both zonations, ranges upward to the Hauterivian from near the base of Zone 4 (late Tithonian) sensu Pessagno, Blome and Longoria, while Baumgartner finds it upward from U.A. 9 (Zone C1 = Kimmeridgian/early Tithonian).

Further evidence of age is found in the Ristola boesii (Parona) Group which ranges from the Tithonian to Hauterivian (Nakaseko and Nishimura, 1981; Pessagno, Blome and Longoria, 1984). Archeodictyomitra rigida Pessagno ranges from the late Kimmeridgian to at least the Berriasian according to Pessagno, Blome and Longoria, while a form very like Stichocapsa naradaniensis Matsuoka belongs to the Gongylothorax sakawanis - - Stichocapsa sp. C Assemblage defined by Yao et al (1982) which is considered to be early late Jurassic (Oxfordian) in age. The complete range of this taxon cannot be found in the literature and it is conceivable Stichocapsa naradaniensis could range higher both in Japan and in the northeastern Pacific.

If identifications were certain of specimens identified as ?"Hsuum" stanleyense Pessagno and Ristola hsui ? Pessagno then

this sample would be no younger than Late Jurassic; however, as this is not the case, a much longer range must be considered.

LOCALITY NO. MB3

Field no. 72-11A of Muller and others (1981)      GSC loc. C-89780

**Location:**      Located at Big Beach on southwest coast of Ucluth Peninsula at end of foot trail on the beach (Figure 13).  $48^{\circ} 56.00'N$ ,  $125^{\circ} 32.17'W$  (corrected from Muller and others, 1981). Buchia shells are found in 20 cm-thick coquina beds in laminated black mudstone. These beds are now highly folded.

**Age:**      Early Cretaceous, middle Valanginian.

J. A. Jeletzky (GSC) identified these fossils as follows (Muller and others, 1981, p. 31-2):

Mid-Valanginian stage, Buchia pacifica zone (Jeletzky, 1965, p.43-49). The apparent absence of closed or gaping, complete (i.e., double valved) shells could be interpreted as suggestive of re-deposition of fauna either by wave action or by turbidity currents.

Buchia pacifica Jeletzky 1965

LOCALITY NO. MB4

Field no. 76-261 of Muller and others (1981)      GSC loc. C-89781

**Location:**      Located on the southwest coast of Ucluth Peninsula (0.75 km south of Ucluelet), on the north side of a bay south of Big Beach area.  $48^{\circ} 56.00'N$ ,  $125^{\circ} 32.67'W$ . Buchia shells are found in 20 cm-thick coquina beds in

black laminated mudstone (similar to locality MB3). Beds are now highly folded.

**Age:** Early Cretaceous, middle Valanginian age (Muller and others, 1981, p. 31-2). Identified by Jeletzky (GSC) as Buchia pacifica Jeletzky 1965.

**LOCALITY NO. MB5**

Field no. 821008-1 of Brandon

GSC loc. C-102719

**Location:** Located near the base of Unit 1B mélange, north of Big Beach. 48° 56.18'N, 125° 33.28'W. These Buchia are found in a folded coquina bed in laminated black mudstone, similar to localities MB3 and MB4.

**Age:** Early Cretaceous, early or ?middle Valanginian.

Fossils were identified by Jeletzky (GSC) as follows (GSC report Km-7-1983-JAJ):

Some part (more likely lower) of Buchia pacifica Zone and of an early or (?)mid-Valanginian age in terms of the international standard stages (see Jeletzky, GSC Bull. 103, 1965, p.43-49, Figs. 1,2,4 and Jeletzky in Jeletzky and Tipper, GSC Paper 67-54, p.7-10, Table I for further details).

Buchia pacifica Jeletzky, 1964 (prevalent)

Buchia tolmatschowi (Sokolov, 1908) (less common)

Buchia sp. indeterminant (?badly deformed representatives of two former species)

**LOCALITY NO. MB6**

Field no. 821008-4 of Brandon

GSC loc. C-102720

**Location:** Located at the base of Unit 1B mudstone-rich mélange where it rests in depositional contact with the underlying Ucluth Formation (the northwest Buchia locality shown in Figure 12). 48° 56.18'N, 125° 33.33'W. Unlike the other localities in this area, these Buchia are not in coquina but are dispersed in a massive black mudstone with minor carbonate concretions.

**Age:** Early Cretaceous, early or middle Valanginian.

The fossils were identified by Jeletzky (GSC) as follows (GSC report Km-7-1983-JAJ):

Most likely the same as for the lot #C-102719. However, all of the numerous Buchias of the lot #102720 are so badly deformed and sheared that the inferred prevalence of B. pacifica over B. tol matschowi may possibly be deceiving. Therefore, the lot #C-102720 could conceivably represent the upper part of the Buchia tol matschowi Zone. In any case, the lot #C-102720 is correlative with the upper part of the One Tree Formation of the Esperanza-Kyuquot area and is of an early to mid- Valanginian age in terms of the international standard stages (see Jeletzky, 1965, Bull. 103 for further details).

Buchia pacifica Jeletzky, 1965 (apparently prevalent)  
Buchia tol matschowi (Sokolov, 1908) (apparently less common).  
Buchia cf. uncitoides (Pavlow, 1970) sensu lato (apparently rare)

#### LOCALITY NO. MB7

Field nos. 82929-1 and 82927-4 of Brandon

**Location:** Large bivalve shells (Inoceramus?) collected from Unit 1B at Big Beach. These samples come from two of the many localities shown in Figures 12 and 13. 82929-1 is located in the center of the map (Figure 13; near the attitude with a dip of 69°) and is found in black laminated mudstone

interbedded with turbidite sandstone and conglomerate. 82927-4 is located at the north end of the map (Figure 13; near the attitude with a dip of  $49^{\circ}$ ), and is also found in mudstone. 82929-1:  $48^{\circ} 56.02'N$ ,  $125^{\circ} 33.00'W$ . 82927-4:  $48^{\circ} 56.22'N$ ,  $125^{\circ} 33.12'W$ .

At these localities and others in the area, the shells are thin calcite layers, everywhere oriented parallel to bedding, and locally with opposing valves of the shell still preserved. The shells are flat in cross-section, range from 25 to 150 cm long and 0.5 to 1.2 cm thick, and are composed of prismatic calcite grains oriented perpendicular to the shell edge. Weathered surfaces reveal a faint rhythmic banding superposed on the prisms and oriented parallel to the length of the shell.

I sent these samples, with thin sections and field photographs, to Dr. E. G. Kauffman, an expert in bivalve and Inoceramid paleontology at the University of Colorado. His report to me is as follows (Kauffman, pers. comm., 1983). He confirmed that they were indeed large bivalves. In thin section, he observed organic material and growth bands preserved in the calcite. Kauffman showed the thin sections to Dr. R. Kligfield who has done extensive research on the development of veins in deformed rocks. Kligfield agreed that the shells represented organic structures and are not veins.

At this time, Kauffman could not make a specific identification. He did say that based on similarities in size and morphology these bivalves probably occupied a similar paleoecological setting as did Cretaceous Inoceramus. He also mentioned that the individuals were adults, probably 10 to 30 years old.

He agreed, based on my photographs and descriptions, that they were preserved in life position.

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