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Windy Craggy
114P/13

Your file / Votre référence

Our file / Notre référence

December 13, 1982

Jan C. Still,
U.S. Bureau of Mines,
Box 550,
Juneau, Alaska 99801,
U.S.A.

Dear Jan:

Please find enclosed the publications you asked for; our compliments. Re our telephone conversation, I presume the volcanogenic deposit you referred to was Orange Point (some how I didn't recall a name being mentioned). Unfortunately, I didn't have a map of the area to refer to when you mentioned the location of the deposit. You will see from map 1505A and Paper 79-1A that this group of rocks lie between the Hubbard (formerly Art Lewis) and Border Ranges Faults (H.F. and B.R.F.) and are postulated to be PPs (Skolai Gp.). On the Tatshenshini R. (114P), Yakutat (1140) sheets (hopefully shortly to appear as Open Files) rocks of this belt will be assigned undifferentiated Skolai Gp. (Penn. - L. Permian: may include Upper Triassic). From the Suspect Terrane view point this is a sliver of Wrangellia sandwiched between Chugach Terrane (W. of B.R.F.) and Alexander Terrane (E. of H.F.). Rocks of this belt are correlated with those occurring in the vicinity of Logan-Walsh Glacier (see O.F. #830), which Dick Campbell, Ed. MacKevett and others feel are definely coextensive with type locality Wrangellia sequences (and it's Skolai Group basement) in neighbouring McCarthy Quadrangle. The rocks of the central and southern parts of this belt are generally more metamorphosed and deformed, and have associated gabbro - serpentinites (another feature of the Wrangellia - Skolai assemblages of the McCarthy Quadrangle - Kluane Ranges). However no fossils have been found over the entire length of this slice of Wrangellia - Skolai rocks, from Yukon - Alaska border at 114°W to B.C. - Alaska border.

Since these rocks are assigned to the Wrangellia package, then the correlation with Windy Craggy is presumably not possible, as the Wrangellia "assemblage" is reputedly not found (or has as yet been found) overlying the Alexander Terrane; so say the advocates of Suspect Terrane ideas. Note also Wrangellia rocks (ie. Nikolai Greenstone) in McCarthy, Logan Glacier and Walsh Glacier are are largely subaerial. However, pillowed

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basic volcanic sequences do exist both in Nikolai Greenstone and Skolai Group in O.F. 831 and at the eastern edge of Alexander Terrane in 114P and also in vicinity of Haines Alaska. (N.B. Windy Craggy area has thick sequences of submarine basic volcanics - with pillows).

The problem with St. Elias Mtns. geology (75% or more of which is underlain by Alexander Terrane rocks), is the existance of "look-alike" packages of rocks both sedimentary and volcanic, which differ in age. Nowhere are there complete stratigraphic sequences, and few fossils have been found (exception being the Devonian and Skolai-Wrangellia rocks of the N.E. Front Ranges). The region has undergone polyphase deformation and diverse faulting. Facies changes and unconformities are strongly suspected, which compound the problem still further. "Glimpses" from sometimes widely separated localities indicate that the Alexander Terrane within the St. Elias Mtns., ranges in age Upper Cambrian or earlier (?) to uppermost Triassic (late Norian). What few fossils that were found (both macro and condonts) indicate that the following ages are present within the Alexander Terrane: Upper Cambrian; earliest and middle Ordovician; late Ordovician-Silurian; Lower, Middle, and Upper Devonian; Carboniferous (? Mississippian); Permian; Middle and Upper Triassic. Thus the whole Paleozoic column and the Triassic could be present. For more details on Alexander Terrane see write-up in legend for O.F. 829, 830, 831. Overlying rocks of the Alexander Terrane with pronounced unconformity are; (a) shallow marine shelf clastic deposits (platformal) of Upper Cretaceous age (Walsh Gl. area, O.F. 830); (b) Paleogene continental (dominantly fluvial) deposits with overlying Mio-Pliocene and younger volcanics (predominantly Wrangell Lava).

Within Alexander Terrane we have recognized the following groupings of volcanic and volcaniclastic rocks.

1. Field Creek Volcanics: (O.F. 831); of undoubted (fossils) Upper Cambrian and/or older age: composed of porphyritic andesite and basalt flows with minor pyroclastics and volcaniclastics.

2. Donjek Ranges Greywacke - Greenstone Assemblage: (O.F. 829, 830, 831); dominantly volcaniclastics, with minor basic flows, and interbedded fine clastics and argillite.

   Northern Alsek Ranges Greywacke - Gabbro assemblage: volcanic derived greywacke, minor thin bedded carbonates and interbedded argillites, local basaltic and andesitic flows - some pillowed; these rocks are extensively intruded by gabbro dykes and/or sills (Eob); (NB. some of the rocks mapped as Eob may be massive flows).

   These two groupings are considered approximate age equivalents and tentatively Cambro-Ordovician in age; possibly, partly facies equivalents to Field Creek Volcanics, no fossils though. Lithologically both groupings are similar to Descon and Wales Group of S.E. Alaska (age Ordovician to Cambrian or older, I believe).

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3. (a) unit lPvs: greenstone-amphibolite, greywacke; with minor argillite, quartzites, and limestone; occurring in vicinity of Mt. Vancouver, Mt. King George, and Centennial Ranges (O.F. 830) and around upper reaches of Chitina and Anderson Glaciers (O.F. 829).

   (b) unit lPvm: amphibolites to S. and S.E. of Mt. Hubbard (O.F. 830) and area between Mt. Alyesworth, and Vern Richie and Battle Glaciers (1140).

   3 (a) & (b) are possibly equivalents of (1) and (2) above - no fossil evidence though.

4. (a) unit uPv: (N.E. corner of O.F. 830): basaltic and andesitic flows with local volcaniclastics of Upper Devonian or younger age - outcropping in Kluane Ranges. These rocks are underlain by very fossiliferous Middle Devonian limestones.

   (b) unit uPv[1]: (O.F. 831) basalt to andesite flows of Alsek R. valley - Dev. or younger (some of these could be as young as Upper Triassic as conodonts of that age are found in adjoining limy shales and thin bedded limestone).

5. Tatshenshini River map-area (114P)

   (a) Datlasaka Ranges: Upper Triassic and/or (?) Permian amydalodial basic volcanics - not extensive in occurrence.

   (b) Survey Lake - Shini Creek - Fault Creek: greenstone - diorite complex: age very uncertain: thus? Paleozoic and/or Mesozoic in age.

   (c) Alsek Ranges and Tsirku Glacier area: "Windy Craggy" area, Buckwell, Tsirku, Herbert Glaciers area: dark greenish grey basalt to andesite pillow lavas and flows; include interbedded limestone, argillite, siltstone and basic intrusions; minor greenstone, greywacke, dacite and acid and basic pyroclastics: age most uncertain Paleozoic and/or (?) younger (Lower Paleozoic to (?) upper Triassic).

As I mentioned to you on the phone, neither Dick Campbell or myself have spent much time on the rocks in the vicinity of Windy Craggy - so these comments are strictly of the "off the top of the head" calibre! We "hedge our bets" (obviously) by assigning a lower Paleozoic to (?) Upper Triassic age to these volcanics. Structurally the area is probably complex and lack of sufficient work in the region doesn't permit us to be more specific than the above. No further field work by the G.S.C. is planned for the area, so any future elucidation will either be from mining interests or possibly the British Columbia Dept. of Mines and Petroleum Resources (Don G. MacIntyre).

The problem as we see it revolves around the following lines of reason: you will hopefully understand this more clearly when you are able to refer to the up coming O.F. for 114 P & O. The nearest fossil find to "Windy Craggy" volcanics are to be found in carbonates to the east (East Arm Gl.). Conodonts from there give Middle Devonian (very specifically latest Eifelian or Earliest Givetian). These carbonates are probably in the

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upper sections of a thick laminated carbonate - calcareous siltstone - limestone unit (ODcs). The lower sections of this carbonate "deck" have yielded Earliest Ordovician (macro fossils) and Early to Middle Ordovician conodonts in other areas. Between these carbonates and the volcanics of the "Windy Craggy" area are a sequence of dark siltstones and argillites - assigned Upper Paleozoic or older (may include Triassic); again we "hedge bets". Since facing directions (tops) have as yet to be established for these units it is a guessing game. At least one of two possibilities exist for the age of the volcanics.

(A) if the rocks of the area (including volcanics obviously) are in a "crudely anticlinal structure", then we suggest a lower Paleozoic age for the volcanics i.e. equivalent to Field Creek Volcanics and/or possibly Cambro-Ordovician Alsek Range Assemblage.

(B) if the rocks of the area are in a "crudely synclinal structure", then they are probably post Middle Devonian and could be Upper Devonian, Permian or even Upper Triassic in age.

However, there is a strong suggestion that structural complexities and/or unconformable stratigraphic relationships could compound the problem - proving above reasoning incorrect.

Currently we favour (A) from the following reasoning. Our best evidence for the age of the volcanics of Windy Craggy area is to be found in the geology to the north in O.F. 831 (S.W. corner). There Field Creek Volcanics occur in a well documented W.N.W. plunging broad anticlinal structure. Rocks overlying this structure are revealed in it's flanks and within an adjoining N.W. plunging synclinal structure. These include units €Owb and ODcs. This geology can be traced to the south (you will see this more clearly when O.F. for 1140 and P are available) into the Range Creek area just to N. of "Windy Craggy problem". There the ODcs unit we feel definitely overlies €Owb in what appears to be an "interferrence" folding pattern - i.e. refolded folds. The "deck" of ODcs then apparently transgresses the Alsek Ranges from E. to W. with three continuous "arms" of these carbonates projecting to the S.E. just to W. & E. of "Windy Craggy situation" (this again strongly suggesting a refolding pattern). Dark siltstone argillite sequences occur as "embayments" in these carbonate successions. Now enter the Windy Craggy volcanic problem. Between carbonates lumped as unit ODcs lie the dark siltstones and argillites. Are these equivalent to €Owb or are they Psp (Icefield Ranges Pelitic assemblage)? Thus the problem, soluble only by further geological work. It is to be noted that within the plunging syncline mentioned above (N. of the anticline exposing Field Creek Volcanics - O.F. 831), laminated carbonates (unit ODcs) are overlain, within a few km of one another, by mid Devonian calcareous argillite - limestone, Permian limestone and clastic sediments and Upper Triassic limestone and calcareous argillites. There also are sparse outcropping of volcanics closeby in Alsek R. valley (unit uPv^{1}), adjacent to Upper Triassic conodont-bearing calcareous argillite and thin to more massively bedded limestones. Are these equivalent to "Windy Craggy" volcanics?

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To add further to this apparent confusion, you may possibly consider correlating the rocks at Orange Point with volcanic rocks assigned to Valdez Group (units KVv, KVvm) or McHugh Complex. The former volcanics occur within Seward Glacier (should be Icefields on maps) - O.F. 830, and are juxtaposed to Yakutat Group rocks and the latter further to W. in Alaska. Chugach Terrane rocks (i.e. Valdez - Yakutat Groups) - extend down to and are present within the Fairweather Ranges (W. of B.R.F.) - extending further S. into Alaska and occuring immediately W. of B.R.F. at Orange Point. Valdez Group rocks in Seward Icefields vary extremely in metamorphic grade (from lowest grades to highest amphibolite grade, with production of granitoid gneiss). From what little work that has been done in Fairweather Ranges by Dick Campbell and George Plafker, it appears this high degree of variance in metamorphic grade is also present in that area.

Yet another (believe it or not!) possibility exists with which you may wish to match correlation of Orange Point rocks. Note the belt of rocks at the western edge of the Alexander Terrane - units lPvs and lPvm as mentioned above under 3 (a) & (b). These rocks in 1140 have been coloured brown (see Current Research papers 79A-1A). "Oddly" enough this belt of rocks (as do the Skolai and (?) Wrangellia - PPsv unit) crudely parallels the H.F. over much of it's length (from McCarthy Quad. to 1140) within St. Elias Mtns. Where is the southern extension of these (?) lower Paleozoic rocks? The rocks of unit lPvm in the Vern Richie - Battle Glacier area are associated with bona fide gneisses quite unlike those of KVgn in Seward Icefields - who knows possibly "old basement" perhaps!! However, Dick Campbell feels that this grouping of rocks (viz lPvs, lPvm) has lithologies not found in the PPsv slice and also carries no gabbro, greenstone, and serpentinites which is more characteristic of that slice. Dick thus strongly doubts that the PPsv slice contains these (?) lower Paleozoic metavolcanic rocks.

One last comment should be aired. A striking (pardon pun!) comparison can be made with the H.F. and B.R.F. bounded "slice" of Wrangellia - Skolai Group rocks and westerly adjacent Chugach Terrane. This is the northeastern boundary of the Alexander Terrane. There the Duke River Fault (D.R.F.) and Denali Fault System (D.F.S.) - two "sizeable" strike-slip faults are juxtaposed from Donjek River (O.F. 829) to Kelsall River (114P) and possibly even further to the south. Close proximity of these two faults has resulted in a melange zone with a jumbled array of anastomosing fault bounded segments of rocks ("knockers"!) involving Wrangellia - Skolai Gp. and Alexander Terrane rocks. The situation is analogous to the western edge of Alexander Terrane, however the Terrane belts are exactly reversed (minor image) with Jura-Cretaceous age deep marine fan deposits (flysch) of the Dezadeash Group lying on the inboard or easterly side. The trace of D.R.F. has beyond any doubt been dislocated probably is several places by lator movements on the D.F.S. and probably related faults strands lying to the S.W. of the "loci" of D.F.S. drawn on the O.F. 829, 830, 831. Check the geology in particular of the N.E. corner of O.F. 830 in Kluane Ranges for one bona fide piece of Wrangellia lying S.W. of the trace of D.R.F. and the belt of rocks (within same area, aptly named "Il Paradiso"! by Gary Eisbacher) which include units uPv to uPe inclusively and associated gabbro-greenstone-volcanic and ultramafics - units PTb, PTub, uPbv (see legend for O.F. 829-831 for description of these units). These rocks all could equally well be Wrangellia - Skolai Group or Alexander Terrane in fact known fossiliferous Devonian limestone

occur there, hence the D.R.F. is place N.E. of this area. Thus you could well be dealing with exactly the same situation within the belt of rock which include Orange Point - this belt is from all accounts equally jumbled - i.e. a melange zone.

Sincerely hope that you manage to "wade" through the above, for it is indeed a little complex, never mind confusing. We apologize a modicum for our apparent lack of comprehension of the stratigraphy within the Alexander Terrane of St. Elias Mountains. However, when you consider the complexity of the geology, the extremely rugged character (to put it mildly) of the region as a whole, and the fact that less than 3 full summers (only 9 weeks in 1140 & P) were spent to map an area equal to 3½ quadrangles, 70% or more of which was mapped by helicopter "fly-by" and spot checks (largely by one individual - viz Dick Campbell), then excuses we feel for lacking a complete understanding of the geology, are surely minimal.

In Summary:

Currently generally accepted opinion is that Orange Pt. metavolcanics are a slice of Wrangellia - Skolai Group or McHugh Complex equivalents bounded by H.F. and B.R.F. and the slightly favoured the age of the volcanics at Windy Craggy is Cambrian or Cambro - Ordovician. Thus no correlation. However in view of the above mentioned uncertainities, the following rather circuitous avenues of reasoning could be leveled - producing an interesting paradox.

I. make PPsv slice (incl. Orange Pt.) between H.F. and B.R.F., Alexander type Permo-Triassic volcanics - by coalescing (on even "mixing up") H.F. with B.R.F. at presently drawn B.R.F. (after all this area is a melange zone). Thus Orange Pt. could be equivalent to Windy Craggy if latter volcanics prove to be upper Paleozoic - Triassic.

II. make Orange Point metavolcanics correlatives of units lPvs and lPvm of Icefield Ranges by same reasoning as in I (viz. H.F. mixed up, moved or coalesced with presently drawn B.R.F.). Thus again Orange Pt. could be equivalent to Windy Craggy, if latter proved to be L. Paleozoic.

III. make Orange Point metavolcanics the same age as volcanics of Valdez Group or McHugh Complex equivalents in Seward Icefield by making B.R.F. coalesce with H.F. (at latter's presently drawn line) or by melange zone mixing of H.F. by later B.R.F. movements. Orange Point then is not equivalent to Windy Craggy - unless rocks at Windy Craggy are very much younger than currently held beliefs.

IV. If Windy Craggy and Buckwell - Tsirku Glacier volcanics are Permo - Triassic, could these be Wrangellia - Skolai on Alexander Terrane. This could make Orange Point equivalent to Windy Craggy, but would certainly contravene the ideas of the Suspect Terrane hypothesis.

Reasoning I, II and III do not conflict with Suspect Terrain ideas; IV would.

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The resultant of all this preamble is that even with all the permutations and combinations listed above, it may still be possible to correlate the Windy Craggy deposit with that of the Orange Point, without conflicting with Suspect Terrane ideas (i.e. if they both turn out to be of the same age) Have fun!!

I urge you to confer with Dave Brew and George Plafker on their collective feelings on this matter; perhaps you have already done this. Please feel free to check with either Dick Campbell or myself on this or related matters at any future date.

Sincerely yours,

C.J. Dodds

CJD/wc

Encl.