

# PERMO-TRIASSIC ISOTOPIC DATES FOR BLUESCHIST, ROSS RIVER AREA, YUKON

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## ABSTRACT

*Rb-Sr and K-Ar age determinations for muscovite-bearing blueschist in the Yukon-Tanana terrane near Ross River indicate a minimum metamorphic age of approximately 250 Ma, and a mid-Paleozoic protolith age. The blueschist is associated with eclogite in a tectonized assemblage of phyllite, quartzite, micaschist, and serpentinite. Neither mid-Jurassic metamorphism nor mid-Cretaceous regional plutonism have affected these high-pressure rocks to the point of resetting the isotopic systems. Parts of the Yukon-Tanana terrane thus record a Late Paleozoic metamorphism. If the blueschist and eclogite were part of the trench melange of the Lewes River Arc, their age implies that the arc was active in Late Paleozoic time.*

## RÉSUMÉ

*Les datations par les méthodes Rb-Sr et K-Ar d'un schiste bleuté à glaucophane contenant de la muscovite, provenant du terrane de Yukon-Tanana près de Ross River, indiquent que le métamorphisme date au minimum d'environ 250 Ma, et que la roche originelle date du Paléozoïque moyen. Le schiste bleuté à glaucophane est associé à de l'éclogite dans un assemblage tectonisé de phyllite, quartzite, micaschiste et serpentinite. Ni le métamorphisme du Jurassique moyen ni le plutonisme régional du Crétacé moyen n'ont modifié ces roches formées dans des conditions de pression élevée au point de remettre à zéro les systèmes isotopiques. Ainsi, des portions du terrane de Yukon-Tanana ont enregistré un métamorphisme d'âge paléozoïque supérieur. Au cas où le schiste bleuté à glaucophane et l'éclogite feraient partie du mélange présent dans la fosse de l'arc de Lewes River, leur âge signifierait que l'arc était actif durant le Paléozoïque supérieur.*

## INTRODUCTION

This note presents the results of Rb-Sr and K-Ar age determinations of blueschist near Ross River, along the tectonic contact between high-pressure metamorphic rocks of the accreted Yukon-Tanana terrane, and lower-grade rocks, dominantly of North American affinity, to the east. The petrology and regional significance of the blueschist and of associated eclogite have been documented previously (Erdmer, 1987); the isotopic data presented here support the published structural and petrologic interpretation. The high-pressure rocks are part of a high-pressure tectonic melange, formed in an Upper Paleozoic arc before being accreted to North America in mid-Mesozoic time. These rocks were not affected by early to mid-Jurassic and mid-Cretaceous regional metamorphism which are pervasive elsewhere in the Yukon-Tanana terrane.

## SETTING

The newly dated rocks are located east of Tintina Fault, in the hanging wall of Vangorda Fault (Tempelman-Kluit, 1972), a northwest-striking, steeply southwest-dipping structure which juxtaposes serpentinite, and mylonitic rocks of Nisutlin Allochthon (Tempelman-Kluit, 1979a), against lower-grade basalt of the Anvil Range Group (Gordey, 1983), and against underlying rocks of North American miogeoclinal affinity to the east. Vangorda Fault is part of the Finlayson Lake fault zone (Mortensen and Jilson, 1985). Other northwest-striking, steeply-dipping faults that occur in the vicinity are related to the Finlayson Lake system or to the Tintina system, and have a complex displacement history that includes early reverse,

strike-slip, and late normal periods of movement (Pigage and Jilson, 1985). The tectonic slice of high-pressure rocks is thus internally disrupted, and highly exotic with respect to adjacent rocks to the east.

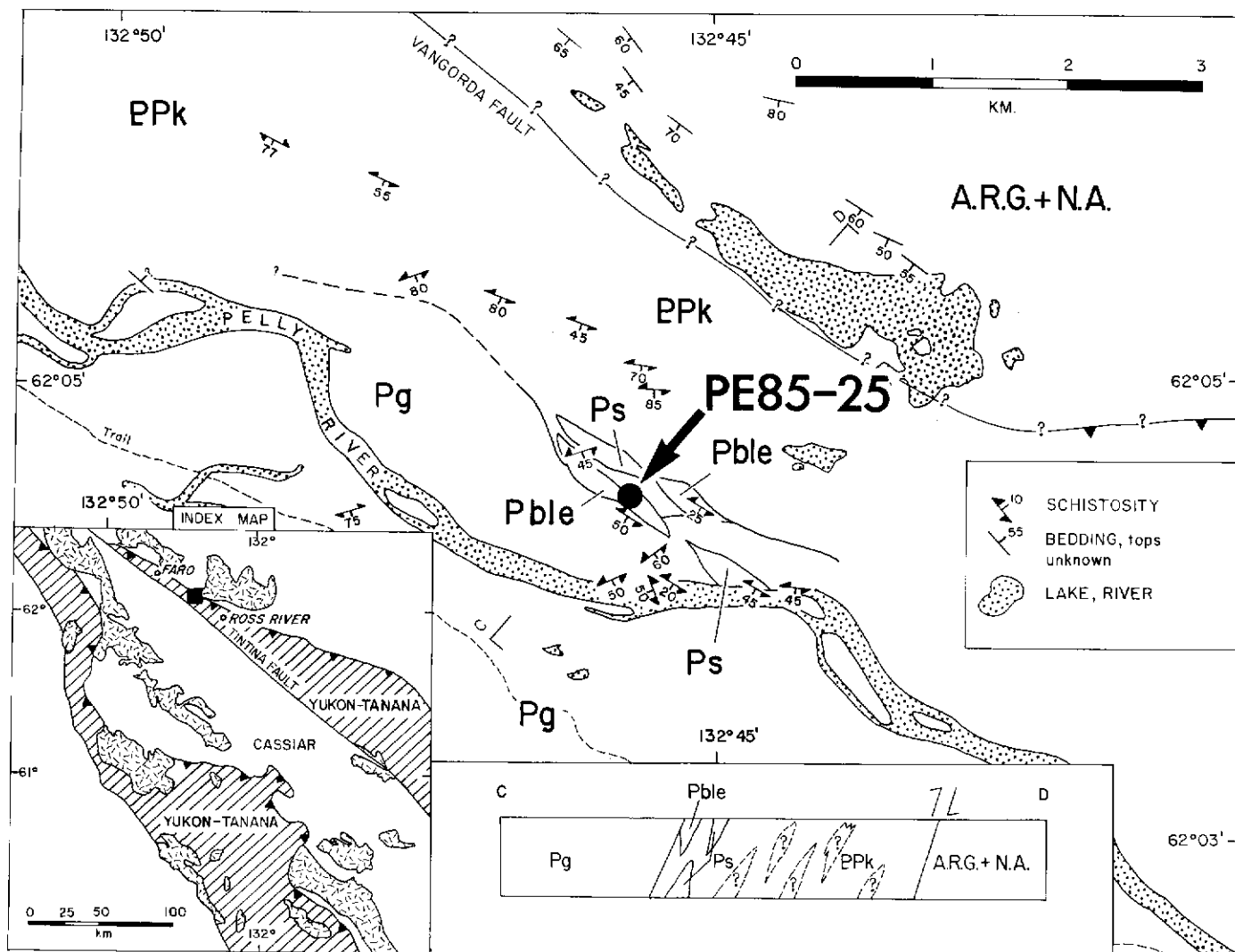
The blueschist locality is easily accessible from the Pelly River, or by a helicopter flight of a few minutes from either Ross River or Faro. The best exposure is on a small knoll at locality PE85-25 (Fig. 1; UTM coordinates E617025, N6884225; Grid Zone 8V, 1:100 000 Square: PD). Blueschist occurs on several hills a few hundred metres long, as quartz-muscovite-glaucophane-garnet schist and as glaucophane-muscovite quartzite. Other associated rock types, more abundant than the glaucophane-bearing rocks, are muscovite phyllite, graphitic quartzite, and biotite micaschist. Compositional layering and schistosity dip moderately to steeply to the southwest.

## RESULTS

A sample of micaceous quartzite (sample 1) and of micaschist (sample 2) were analyzed. Isotopic data are given in Table 1.

Rb-Sr determinations on whole rock and muscovite yield concordant muscovite dates at approximately 246 Ma. The indicated whole rock age is approximately 344 Ma, which suggests a protolith of Mississippian or somewhat older age for the metasedimentary sequence. The protolith age of the accompanying eclogite is unknown. It is assumed to be Mississippian or younger as the eclogite is probably derived from basic dykes or sills intruded into the metasedimentary sequence.

The K-Ar dates are slightly older (256 and 267 Ma), but their two sigma errors overlap the Rb-Sr results, and the age difference is not considered geologically significant.



**Figure 1.** Geological setting and location of the blueschist locality near Ross River. Abbreviations: PPk: mylonitic phyllite, graphitic quartzite, and micaschist; Pble: blueschist and eclogite; Pg: actinolite and hornblende greenstone; Ps: serpentinite; A.R.G.+ N.A.: rocks of the Anvil Range Group and of North American affinity (see text). Symbols: teeth on thrust fault are in hanging-wall. Index map symbols: hachures: Yukon-Tanana terrane; dash pattern: mid-Cretaceous quartz-monzonite plutons; Cassiar terrane includes rocks equivalent to N.A. strata. Geology after Tempelman-Kluit 1972, from personal communication by G.A. Jilson, and from field work in 1985 and 1986.

## DISCUSSION

The Late Permian/Early Triassic minimum age (250 Ma) of metamorphic muscovite in the blueschist is comparable to a mid-Permian age of 258 Ma (recalculated using modern constants from an age of 255 Ma) obtained by Wanless et al. (1978) for muscovite in eclogite at Faro, 30 km along strike in the same tectonic slice.

Two main conclusions can be drawn. The first is that neither regional mid-Cretaceous plutonism (exemplified by the Anvil Batholith near Faro, emplaced approximately 100 Ma ago (Pigage and Anderson, 1985) nor early to mid-Jurassic metamorphism in the Yukon-Tanana terrane (160-180 Ma isotopic dates, Tempelman-Kluit and Wanless, 1975; 185-213 Ma dates, Hansen, 1987) have affected the blueschist and eclogite. Parts of the Yukon-Tanana terrane thus preserve a record of Late Paleozoic metamorphism.

The second conclusion is that although cataclasis is Late Triassic or younger as recorded in rocks of Nisutlin Allochthon (Upper Triassic conodonts in deformed parts of Nisutlin Allochthon, Tempelman-Kluit, 1979b; and Rb-Sr data for the Klondike Schist which suggest an age of cataclasis of 202 Ma, Metcalfe and Clark, 1983), the 250 Ma minimum age of peak metamorphism and ductile deformation in the high-pressure rocks is distinctly older. If the blueschist and eclogite were part of trench melange of the Lewes River Arc (Tempelman-Kluit, 1979a), the arc must have been active in Late Paleozoic time (see discussion in Erdmer, 1987). The isotopic age

also implies that high-grade fabrics in other parts of Nisutlin Allochthon may have developed during the late Paleozoic, rather than during the Mesozoic. Early Triassic to Late Paleozoic K-Ar dates for muscovite (245 Ma) and amphibole (278 Ma) of the Clinton Creek area (Htoon, 1979) are another example where Paleozoic isotopic dates are preserved in the Yukon-Tanana terrane. It is worth noting that all known localities for older dates are located in the northernmost part of the terrane in Canada.

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Table 1. Analytical results

A. Rubidium-strontium data from whole rock analysis and muscovite

Sample No.	Type	ppm Sr ± 5%	ppm Rb ± 5%	Rb/Sr ± 2%	$^{87}\text{Rb}/^{86}\text{Sr}$	± 0.01% $^{87}\text{Sr}/^{86}\text{Sr}$	Age (Ma) ± 10	Initial $^{87}\text{Sr}/^{86}\text{Sr}$	Comments
PE85-25 (1) WR	micaceous quartzite whole rock	44.6	54.9	1.232	3.57	0.72457	344 ± 10	0.7071 ± 2	Whole rock age is mid-Paleozoic
MS	muscovite	60.2	269.5	4.47	13.01	0.75762	246 ± 7	0.7121 ± 5	
PE85-25 (2) WR	micaschist (whole rock)	223	63.6	0.286	0.827	0.71114	249 ± 6	0.7082 ± 1	Concordant muscovite dates at = 246 Ma
MS	weakly magnetic muscovite	111	182	1.643	4.76	0.72507	246 ± 4	0.7063 ± 1	
MSNM	nonmagnetic muscovite	109	209	1.914	5.55	0.72749	243 ± 6	0.7083 ± 1	

B. Potassium-argon data for muscovite

Samples No.	Type	%K	$^{40}\text{Ar}^* \times 10^{-6} \text{cm}^3/\text{g}$	$^{40}\text{Ar}^*/^{40}\text{Ar}$ total	Age (Ma) ± 10
PE85-25 (1)	muscovite	8.51 ± 0.06	90.769	0.891	256 ± 8
PE85-25 (2)	muscovite	7.60 ± 0.10	84.885	0.904	267 ± 8

Ar\* indicates radiogenic argon.

All analyses were done at the Geochronometry Laboratory, Department of Geology, University of British Columbia, by D. Runkle, R.L. Armstrong, and J. Harakeel.

Rb and Sr concentrations were determined by replicate analysis of pressed powder pellets using x-ray fluorescence. U.S. Geological Survey rock standards were used for calibration; mass absorption coefficients were obtained from Mo Ka Compton scattering measurements. Rb/Sr ratios have a precision of 2% (1). Sr isotopic composition was measured on unspiked samples prepared using standard ion exchange techniques. The mass spectrometer, V.G. Isomass 54R, has data acquisition digitized and automated using a H.P. 85 computer. Experimental data have been normalized to a  $^{86}\text{Sr}/^{88}\text{Sr}$  ratio of 0.1194 and adjusted so that the NBS standard  $\text{SrCO}_3$  (SRM987) gives a  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio of  $0.71020 \pm 2$  and the Eimer and Amend Sr a ratio of  $0.70800 \pm 2$ . The precision of a single  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio is  $\pm 0.00010$  (1). Rb-Sr dates are based on a Rb decay constant of  $1.42 \times 10^{-11} \text{a}^{-1}$ . Regressions are calculated according to the technique of York (1967).

K is determined in duplicate by atomic absorption using a Techtron AA4 spectrophotometer and Ar by isotope dilution using an AEI MS-10 mass spectrometer and high purity  $^{36}\text{Ar}$  spike. The constants used are:

$$K_e = 0.581 \times 10^{-10} \text{a}^{-1}, K_B = 4.962 \times 10^{-10} \text{a}^{-1}, 40\text{K}/\text{K} = 0.01167 \text{ atom percent.}$$

Decay constants are those recommended by the IUGS Subcommittee on geochronology (Steiger and Jager 1977). Errors reported are for one standard deviation or the standard error on the mean, unless otherwise noted.

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