Data Repository item 2004105

DATA REPOSITORY FIGURES

Figure DR1. A. Phyllitic fabric wraps around clinopyroxene crystal in deformed French Range tuffaceous strata (field of view is about 4 mm).

B. Vesicular, bright green, tabular plagioclase porphyritic lapilli tuff.

C. Basalt tuff overlain by olistostromal carbonate with a volcanic matrix which grades up into pisolitic carbonate.

D. Ignimbritic rhyodacitic tuff that displays eutaxitic textures.

Figure DR2A. Fusulinid packstone outcrop and, B. in thin section showing calcareous and silicified (to right) fossils. This sample (MMI99-34-8) contains the fusulinid *Colania* sp. Ex gr. *C. columbiana* (Dawson) of Wordian (probable late Wordian) age (Middle Permian; Lin Rui, written communication 2001). Field of view is approximately 4 mm. C. branching bryozoans preserved in weakly recrystallized limestone.

Figure DR3. $^{40}Ar/^{39}Ar$ correlation and release specra for the non-magnetic fraction of Sample MMI96-17-4B.

Figure DR4. Simplified regional geology of the Lisadele Lake area, after Mihalynuk et al. (1995a, b). Ammonite and radiolarian sample sites are shown. Three digit numbers adjacent the site localities correspond to the last three digits of the GSC – series numbers in tables DR1 and DR4.

DATA REPOSITORY TABLES

Data Repository Table DR1. Radiolarian age determinations from chert granules in Bajocian conglomerate.

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Data Repository Table DR2a. $^{40}Ar/^{39}Ar$ isotopic age spectra data for French Range blueschist samples MMI96-17-4 and MMI96-17-4B.

Data Repository Table DR2b. $^{40}Ar/^{39}Ar$ age spectra data for analyses of non-magnetic fraction of sample MMI96-17-4B.

Data Repository Table DR3. U-Pb isotopic data, French Range rhyodacite, sample MMI96-17-7 and Slaughterhouse pluton, samples MMI96-2-11 and MMI96-16-3.

Data Repository Table DR4. Ammonite age determinations from the Lisadele Lake area

DATA REPOSITORY REFERENCES

Mihalynuk, M.G., Meldrum, D., Sears, W.A., and Johannson, G. G., 1995a, Geology of the Stuhini Creek area (104K/11), *in* Grant, B., and Newell, J.M., eds., Geological Fieldwork 1994: B.C. Ministry of Energy, Mines and Petroleum Resources, Paper 1995-1, p. 321-342.

Mihalynuk, M.G., Meldrum, D., Sears, W.A., Johannson, G. G., Madu, B.E., Vance, S., Tipper, H.W., and Monger, J.W.H., 1995b, Geology and lithogeochemistry of the Stuhini Creek map area (104K/11): B.C. Ministry of Energy, Mines and Petroleum Resources Open File 1995-5, 1 : 50,000 scale.

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Data Repository

Description of lithologies in the French Range, northwestern British Columbia

French Range Formation

Volcanic rocks of the French Range Formation consist of mint-green basalt tuff and greenish brown tuffite, massive fine-grained flow breccia, pillowed flow units, sparse interlayers of red trachyandesite lapilli tuff, and at least one layer of rhyodacite tuff. Units are typically 1 to 15 m thick, locally attaining thickness of several hundred metres. Beds of limestone debris, ferruginous chert and irregular pods of jasper are intercalated with the volcanic strata.

Basalt

Basaltic rocks occur principally as submarine tuff and lesser tuffite. Flows comprise 10 per cent or less of the unit. Monomict, aquagene tuff is the dominant rock type; it is typically metamorphosed to aphanitic chlorite-white mica phyllite with wispy layers of fine-grained blue amphibole. Rare, relict pyroxene phenocrysts up to several millimetres in diameter are outlined by phyllitic fabric (Fig. DR1A). One unit, about 40 m thick, is comprised of 20 per cent highly vesicular, bright green lapilli and breccia clasts consisting of 30 per cent or more coarse-bladed plagioclase (Fig. DR1B).

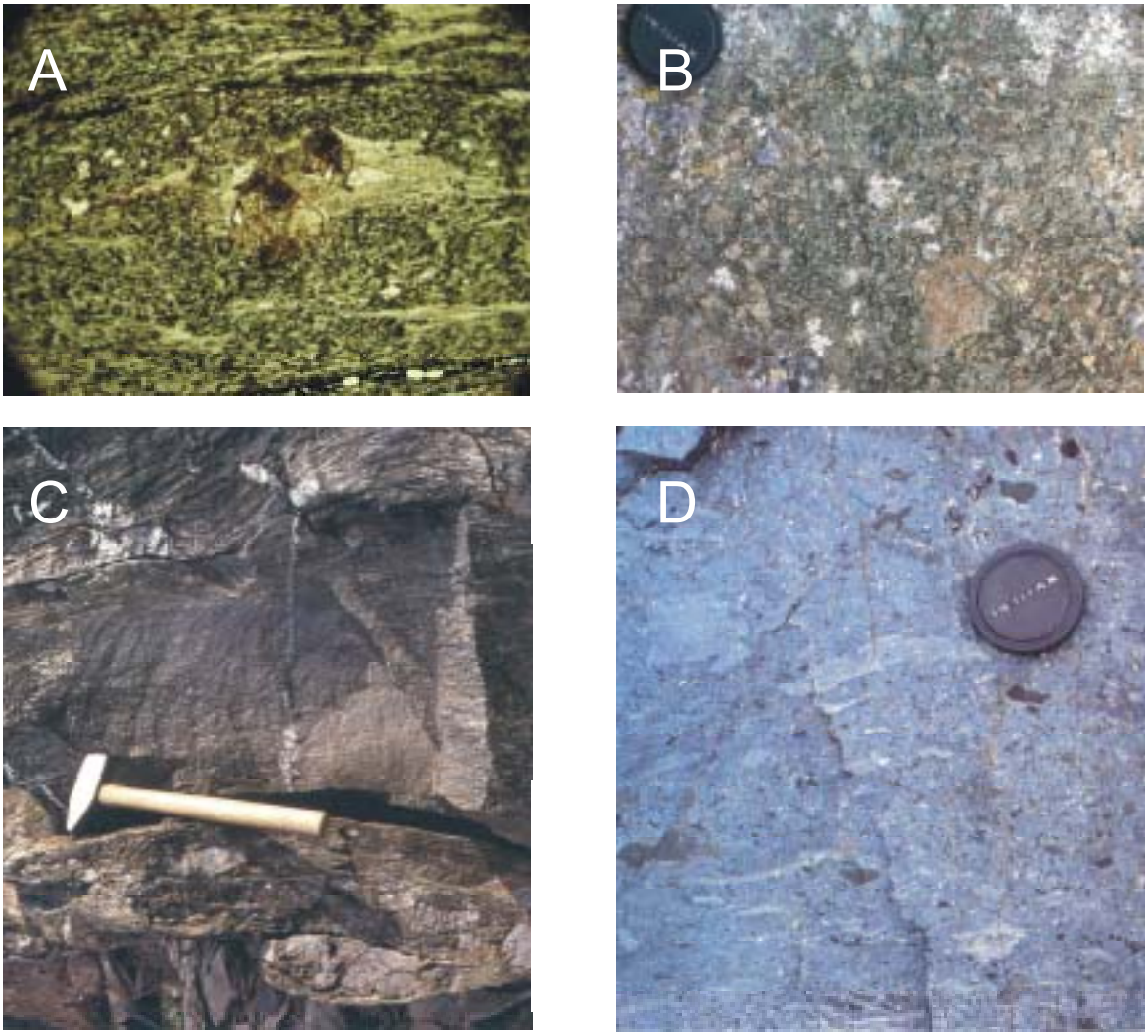

Fig. DR1

Tuffite is commonly altered, and delicate laminations are rarely preserved. Layering is most obvious where laminae alternate from deep green to tan. Laminae can be traced for tens of centimetres, but are disrupted and discontinuous where affected by later folding. In many places, tuffite grades into flattened limestone pebble conglomerate with up to 80 per cent limestone clasts (Fig. DR1C). Olistostromal limestone blocks up to ten metres across are common. Other volcaniclastic layers comprise a minor component of bright red crinoidal grainstone. Interbeds of black or red chert and green or maroon ash tuff are common. Volumetrically minor, bright red ferruginous chert layers up to 0.5 metres thick are infolded with the tuffaceous rocks.

Basaltic flow rocks locally display well-preserved pillows and rare lobes. At least one massive layer within pillow breccia is more than 6 m thick and appears to be a feeder dike. Undeformed pillows are

typically 30 cm across, ranging up to 1.5 m in diameter. Chloritized pillow rinds are locally rich in blue amphibole. Epidote-rich cores host wisps of glaucophane. Rare vesicles are filled with of calcite, chlorite or stilpnomelane. Interpillow fill includes weakly to moderately recrystallized micrite and, less commonly, jasper. Interpillow chert has not been observed.

Trachyandesite tuff

Red-weathering trachyandesite lapilli tuff is weakly to moderately foliated and grades into limestone or carbonate debris flow units. The thickness of tuff units is generally a few metres. Trachyandesite tuff may be monomictic or polymictic. Most is polymictic, although mineralogy and silica content appear to vary little. An exception is a 2 to 3 metre thick unit that contains variegated clasts that broadly range from basalt to dacite in composition. Locally, the clasts are well rounded. Some tuffaceous layers display ripple cross-stratification. At one locality, centimetre-high sinuous ridges on a bedding plane appear to be wave ripple crests.

Rhyodacite lapilli tuff

Variably blue, white and red rhyodacite lapilli tuff forming a layer 3-10 m thick is confined to a single ridge shown near the center of Figure 2. The unit is mainly tholeiitic rhyodacite (Mihalynuk and Cordey, 1997). It contains sparse, fine embayed quartz phenocrysts and is overprinted by fine acicular blue amphibole. Where best exposed, it contains lapilli with features that resemble eutaxitic structures (Fig DR1D). However, neither in outcrop nor in thin section is it possible to demonstrate that the banded and flattened aspect of the volcanic clasts is due to welding rather than to compaction following lithification. A sample of rhyodacite has yielded a U-Pb zircon date of 263.1 +1.0/-1.4 Ma, the only known protolith isotopic date for northern Cache Creek rocks (see U-Pb Geochronology).

Teslin Formation limestone

The Teslin Formation includes recrystallized grey limestone, cryptocrystalline black limestone, and tuffaceous limestone.

Recrystallized grey limestone is bioclastic, medium to light grey and blue-grey, and forms 0.1 m to 2 m thick beds in sections up to several hundred metres thick. Beds are comprised of subangular silty limestone fragments or silicified crinoid bioclasts, and less commonly, gastropods, fusulinids (Figs. DR2A, B) and rare recrystallized ammonites. Beds of cemented limestone pebbles are 0.5 to 1cm thick. Sparse beds of oncolites 2 to 20 mm in diameter are 1-10 cm thick. Stylolites are locally developed; although veins are sparse. Recrystallized limestone is more abundant than cryptocrystalline limestone, from which it is thought to be derived.

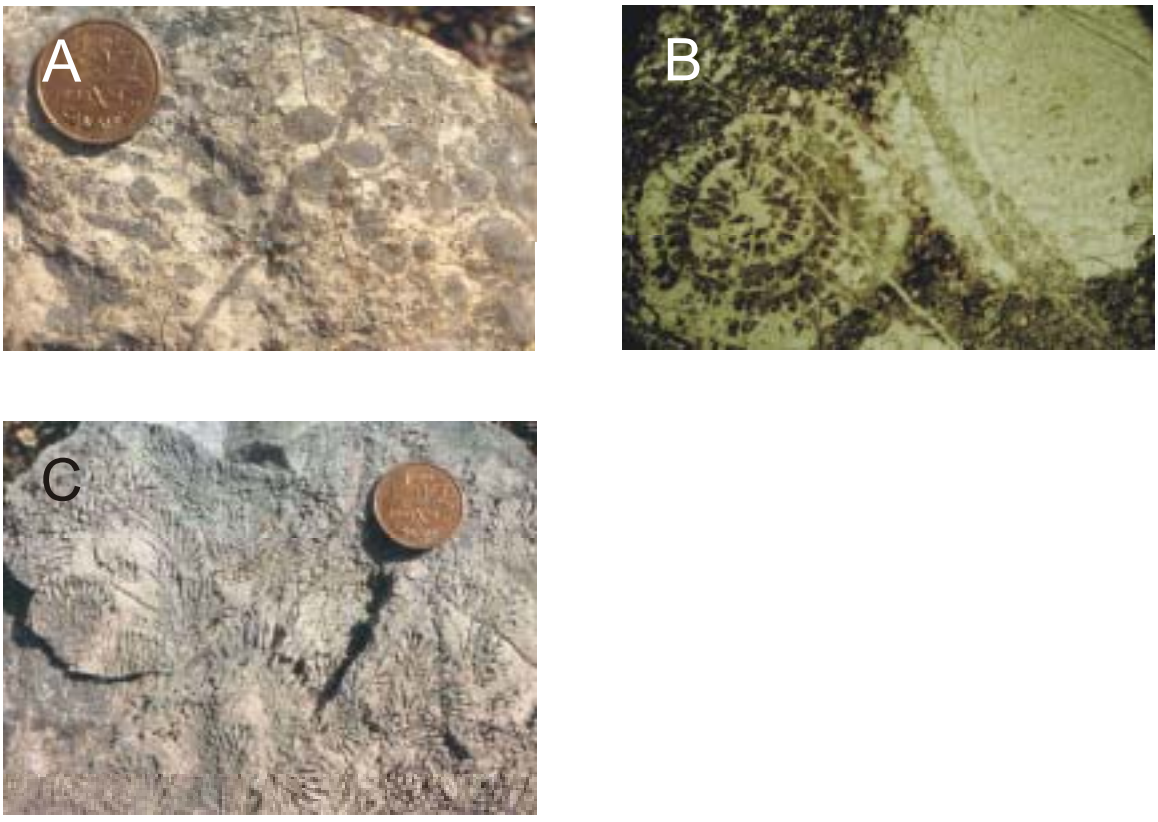

Figure DR2.

Cryptocrystalline black limestone is micritic to rarely bioclastic. It is generally several tens of meters thick with individual beds 3 to 15 cm thick. Where well bedded, it is dark grey to black. Poorly bedded

sections weather white, buff or pink and are light to dark grey on fresh surfaces. Maximum thickness commonly exceeds 200 m. Intermittently exposed, poorly bedded sections locally exceed 400 m in thickness with strike lengths in excess of 12 kilometres. Flint occurs in limestone, as semicontinuous layers 10 cm thick comprised of irregular networks of dark-grey to black, 1 to 10 cm diameter nodules. Delicate branching fossil bryozoans are locally common (Fig. DR2C). They extend into flint nodules, demonstrating that the flint is secondary; depositional intercalation of limestone and chert was not observed.

Tuffaceous limestone consists of light grey pebble and cobble-sized clasts of limestone in a green and maroon tuffaceous matrix with beds generally 3-4cm thick and ranging up to 10cm. It is commonly maroon to ochre weathering. Some resistant tan layers are less tuffaceous. In places, the limestone component is dominated by crinoidal grainstone. It is locally dolomitized, and occasionally displays fibrous blue amphibole concentrated near the carbonate-tuff interface. Dolomitic grey limestone also occurs near contacts with other rock types and is commonly tuffaceous. Rare conglomerate with rounded cobble to granule-sized clasts of polymictic volcanic rocks included in the tuffaceous limestone unit is interpreted as the product of subaerial erosion. Carbonate blocks are common throughout the French Range Formation. We infer them to be olistostromal, dislodged by submarine volcanic processes or the failure of over-steepened volcanic edifices. Because carbonate clasts show the effects of flattening and the chloritic tuff matrix is phyllitic, the olistostromal units are strain markers. They record moderate flattening. Tuffaceous limestone grades into volcanic rocks and commonly occurs adjacent to tuffaceous, glaucophane-rich chert.

Age constraints for the Teslin Formation are provided by fusulinids, which are locally abundant and generally recrystallized, silicified or both (Fig. DR2A, B). Fossils recovered from the Teslin Formation are Leonardian to Guadalupian in age (late Lower to Middle Permian; Monger, 1969).

Hemipelagite

Hemipelagite includes pelite, semipelite and ribbon chert in the Kedahda Formation and tuffaceous and ferruginous massive chert within the French Range Formation. The Kedahda Formation is dominated by grey-green to tan, 1-5 cm thick chert beds with thin clay partings locally up to 5 mm thick. Silicified radiolaria are common, and are locally well preserved. Kedahda Formation hemipelagites underlie vast areas of poorly exposed lowlands and may attain a structural thickness of several kilometres, but strong deformation does not permit an accurate assessment of original thickness.

TABLE DR1. Radiolarian age determinations from chert granules in Bajocian conglomerate.

SAMPLE No	LOCATION	RADIOLARIAN TAXA	AGE REPRESENTED (or part of interval)
MMI99-33-8	104J/09	recrystallized sphaeromorphs **COMMENTS**: red chert, not in place (matrix), red clays silica fragments	Phanerozoic
MMI99-33-9	104J/09	moderately recrystallized sphaeromorphs **COMMENTS**: grey chert with slaty interlayers (in contact with limestone unit); extracted silica rods (sponge spicules or poorly preserved radiolarians), silica fragments (matrix), clays	Phanerozoic
MMI99-34-12	104J/09	*Hagiastrum* sp., ?*Parahsuum* sp., *Orbiculiforma* sp., ?*Praeconocaryomma* sp., *Thurstonia* sp. **COMMENTS**: black cherty argillite bed, 10 cm below red layer marker.	**Early Jurassic (Hettangian-Aalenian)** based on the occurrence of *Thurstonia* (several specimens).
MMI99-34-15	104J/09	unidentified nassellarians **COMMENTS**: red chert, from talus; black, pyritic siliceous argillite interbedded with green silt	Phanerozoic
FC99-1001	104J/09	rare, non-diagnostic sphaeromorphs **COMMENTS**: red ribbon chert, from talus	Phanerozoic
FC99-1002	104J/09	non-diagnostic sphaeromorphs **COMMENTS:** red ribbon chert, from talus	Phanerozoic
FC99-1003	104J/09	poorly-preserved spumellarians **COMMENTS:** red ribbon chert, from talus	Phanerozoic
FC99-1004	104J/09	?*Annulotriassocampe* sp., *Muelleritortis* sp. ?*Pseudostylosphaera* sp., Nassellaria gen. sp. indet. **COMMENT**: red ribbon chert, from talus	**Middle Triassic (Anisian-Ladinian)** based on the occurrence of *Muelleritortis*
FC99-1005	104J/09	poorly preserved radiolarians **COMMENTS**: red-brown ribbon chert, in situ	Phanerozoic
FC99-1005bis	104J/09	?*Entactinia* sp. **COMMENTS**: red-brown ribbon chert, in situ	**Phanerozoic, possibly Paleozoic**
FC99-1006	104J/09	poorly preserved radiolarians **COMMENTS**: red ribbon chert, in place	Phanerozoic

MMI94-19-6 (clasts) GSC: C- 208219	104K/11 Lisadele Lk.	*Canesium lentum* Blome, *Canoptum* sp., *Capnodoce* sp. - *Capnuchosphaera* sp., *Corum* cf. *perfectum* Blome, *Pachus* sp., *Pseudoeucytis*(?) sp., *Praesarla* sp., *Praeconocaryomma* cf. *immodica* Pessagno and Poisson *Pseudostylosphaera* cf. *acrior* Bragin, *Xipha striata* Blome, *Yeharaia elegans* Nakaseko and Nishimura **COMMENTS:** preservation is good, geological unit is Laberge Group, lithology is chert pebble conglomerate. The association is a mixing of radiolarians of various ages extracted from several chert clasts and chips. Also contains sponge spicules (non diagnostic).	Middle Triassic (late Anisian-Ladinian) Middle Triassic (late Anisian-early Ladinian) Late Triassic (Carnian-middle Norian) (late Carnian- Middle Norian) Early Jurassic (Pliensbachian-Toarcian)
SSE94-48-9 (matrix) GSC: C-208220	104K/11	occurrence of radiolarians not established **COMMENTS:** geological unit is Laberge Group, lithology is chert pebble conglomerate	undetermined
SSE94-48-9 (clasts) GSC: C-208220	104K/11	*Canoptum* sp., *Capnodoce anapetes* De Wever, *Capnodoce* sp., *Oertlispongidae*-type rods, *Pachus* cf. *longinquus* Blome, *Plafkerium* sp., *Pseudoalbaillelia* aff. *scalprata* Holdsworth and Jones, *Pseudoeucyrtis*(?) sp., *Praeconocaryomma* cf. *immodica* Pessagno and Poisson, *Pseudostylosphaera* cf. *acrior* Bragin, *Quinqueremis* sp. **COMMENTS:** preservation is moderate, geological unit is Laberge Group, lithology is chert pebble conglomerate. The association is a mixing of radiolarians of various ages extracted from several chert clasts and chips. Also contains sponge spicules (non diagnostic).	Early Permian (Sakmarian-Artinskian) Middle Triassic (late Anisian-Ladinian) Late Triassic (Late Carnian-Middle Norian) Early Jurassic (Pliensbachian-Toarcian)
SVA94-2-4 (matrix) GSC: C-208221	104K/11	occurrence of radiolarians not established **COMMENTS:** geological unit is Laberge Group, lithology is chert pebble conglomerate. Also contains large sphaeromorphs.	undetermined
SVA94-2-4 (clasts) GSC: C-208221	104K/11	*?Capnodoce* sp., *?Kalherosphaera* sp., *?Plafkerium* sp., *?Sarla* sp., *Thurstonia* sp. **COMMENTS**: preservation is poor, geological unit is Laberge Group, lithology is chert pebble conglomerate. The association is a mixing of radiolarians of various ages extracted from several chert clasts and chips.	possibly Middle or Late Triassic; possibly Late Triassic (late Carnian-Middle Norian) Early Jurassic (Hettangian-Toarcian)

Figure DR2a. Ar/Ar age spectra data for MMI96-17-4 S.G. >2.85 fraction

Can/Pos: 147/A47 JValue: 0.007094
00014

Volume 39K: 18.44 x 1E-10 cm3 NTP Approx. % K
Integrated Age: 164.40 ± 0.65 Ma % Ca

Initial 40/36: 1163.29 ±1502.88 (MSWD = 1.03, isochron between 0.00 and 3.00)
Correlation Age: 157.95 ± 23.97 Ma (59.1% of 39Ar, steps marked by >) MSWD 1.383

Plateau Age: 173.71 ± 0.84 Ma (59.1% of 39Ar, steps marked by <) Mod.err. 0.89

Power	36Ar/40Ar	39Ar/40Ar	r	Ca/K	%40Atm	%39Ar	40Ar*/39K	Age
0.50	0.000823±0.000056	0.094854±0.001126	0.012	0.230	24.22	4.48	7.98±0.20	99.4± 2.4
0.75	0.000102 0.000040	0.077062 0.000589	0.122	0.330	3.02	8.75	12.58 0.13	154.3 1.5
<1.00>	0.000100 0.000025	0.068421 0.000486	0.068	0.320	2.94	13.16	14.18 0.13	173.0 1.5
<1.25>	0.000107 0.000022	0.067511 0.000456	0.043	0.310	3.16	17.72	14.34 0.13	174.8 1.5
<1.50>	0.000122 0.000025	0.067968 0.000548	0.056	0.370	3.59	14.44	14.18 0.14	173.0 1.6
<1.75>	0.000093 0.000028	0.068236 0.000502	0.093	0.350	2.74	13.79	14.25 0.13	173.8 1.5
2.00	0.000113 0.000035	0.068868 0.000516	0.117	0.500	3.33	11.18	14.04 0.13	171.3 1.6
2.25	0.000126 0.000102	0.070338 0.000596	0.402	1.050	3.72	7.83	13.69 0.16	167.2 1.8
2.50	0.000266 0.000155	0.073506 0.000823	0.427	1.300	7.84	3.38	12.53 0.24	153.7 2.8
3.00	0.000272 0.000178	0.077172 0.000822	0.508	1.400	8.01	3.81	11.92 0.22	146.4 2.6
3.50	0.002057 0.000488	0.098871 0.002211	0.051	1.700	60.54	0.50	3.97 1.40	50.1 17.5
8.00	0.002147 0.001235	0.117689 0.003491	0.841	10.027	63.08	0.96	3.12 0.79	39.5 9.9

Power	40Ar	39Ar	38Ar	37Ar	36Ar	Blank 40Ar	Atmos 40/36	
0.50	8.758±0.019	0.827±0.010	0.018±0.001	0.003±0.000	0.009±0.000	0.016	293.402	
0.75	20.989 0.021	1.611 0.012	0.023 0.001	0.004 0.000	0.004 0.000	0.018	293.402	
<1.00>	35.564 0.046	2.423 0.017	0.032 0.001	0.005 0.000	0.006 0.001	0.017	293.402	
<1.25>	48.501 0.046	3.260 0.022	0.042 0.002	0.006 0.000	0.008 0.001	0.017	293.402	
<1.50>	39.270 0.057	2.658 0.021	0.035 0.002	0.006 0.000	0.008 0.001	0.018	293.402	
<1.75>	37.347 0.057	2.538 0.018	0.033 0.002	0.005 0.000	0.006 0.001	0.017	293.402	
2.00	30.015 0.045	2.059 0.015	0.027 0.001	0.005 0.000	0.006 0.001	0.018	293.402	
2.25	20.569 0.030	1.442 0.011	0.020 0.001	0.005 0.000	0.006 0.001	0.018	293.402	
2.50	8.505 0.020	0.624 0.006	0.011 0.001	0.005 0.000	0.005 0.000	0.019	293.402	
3.00	9.138 0.020	0.704 0.006	0.013 0.001	0.005 0.000	0.006 0.000	0.018	293.402	
3.50	0.958 0.005	0.095 0.002	0.005 0.001	0.005 0.000	0.005 0.000	0.018	293.402	
8.00	1.528 0.007	0.180 0.002	0.010 0.001	0.005 0.000	0.007 0.000	0.018	293.402	

Measured volumes are x 1E-10 cm3 NTP. All errors are 2 x standard error.

Table DR2b. $^{40}Ar/^{39}Ar$ age spectra data for MMI96-17-4B non-magnetic

Run date: 2004/03/03 **Can/Pos:** 147/A51 **J Value:** 0.007094
Printed: 2004/03/03 **Mass:** 1.0 mg ± 0.000024

Volume 39K: 0.38 x 1E-10 cm3 NTP **Approx.** 2.07% K
1.49% Ca

Integrated Age: 177.04 ± 8.34 Ma

Initial 40/36: 309.44 ± 29.73 **(MSWD = 0.72, isochron between 0.57 and 1.85)**

Correlation Age: 171.81 ± 8.63 Ma (100.0% of 39Ar, steps marked by >) **MSWD** 0.770

Plateau Age: 170.22 ± 7.25 Ma (80.0% of 39Ar, steps marked by <) **Mod. err.** 7.41

Power	36Ar/40Ar	39Ar/40Ar	r	Ca/K	%40Atm	%39Ar	40Ar*/39K	Age
0.75	0.002283±0.000517	0.022277±0.001248	0.017	2.209	67.41	2.87	14.61± 6.88	177.9± 79.8
< 1.50	0.000616 0.000303	0.057159 0.001991	0.003	1.555	18.17	12.68	14.31 1.65	174.4 19.2
7.00	0.002398 0.000203	0.017414 0.000657	0.018	0.699	70.81	7.02	16.74 3.50	202.5 40.1
0.50	0.002729 0.000310	0.008130 0.000622	0.062	0.229	80.62	1.74	23.82 11.18	281.7 122.4
0.75	0.002065 0.000365	0.031159 0.001469	0.009	0.330	60.96	5.39	12.51 3.52	153.4 41.3
< 1.00	0.000846 0.000342	0.051404 0.001816	0.006	0.289	24.95	10.27	14.59 2.04	177.7 23.6
< 1.50	0.000349 0.000163	0.062268 0.001452	0.002	0.372	10.29	23.23	14.40 0.85	175.5 9.8
< 1.75	0.000381 0.000296	0.065629 0.001634	0.001	0.351	11.25	12.44	13.52 1.38	165.2 16.1
< 2.00	0.000177 0.000325	0.067071 0.001813	-0.000	0.355	5.23	11.29	14.13 1.48	172.3 17.2
< 2.25	0.000413 0.000515	0.071604 0.002674	0.001	1.057	12.18	8.32	12.26 2.18	150.5 25.7
< 2.75	0.000749 0.002242	0.068030 0.005572	0.001	1.346	22.09	1.80	11.45 9.80	140.8 116.0
3.75	0.001706 0.002306	0.056172 0.005098	0.006	1.855	50.33	1.29	8.83 12.18	109.6 146.6
7.00	0.003100 0.000149	0.002412 0.000290	0.362	3.032	91.59	1.65	34.86 15.95	398.6 163.6

Power	40Ar	39Ar	38Ar	37Ar	36Ar	Blank 40Ar	Atmos 40/36
0.75	0.510±0.004	0.011±0.001	0.001±0.000	0.003±0.000	0.002±0.000	0.019	282.321
< 1.50	0.868 0.006	0.049 0.002	0.001 0.000	0.008 0.001	0.001 0.000	0.021	282.321
7.00	1.557 0.009	0.027 0.001	0.002 0.000	0.002 0.000	0.004 0.000	0.020	282.321
0.50	0.833 0.005	0.007 0.000	0.002 0.000	0.001 0.000	0.003 0.000	0.018	282.321
0.75	0.679 0.005	0.021 0.001	0.001 0.000	0.001 0.000	0.002 0.000	0.019	282.321
< 1.00	0.783 0.007	0.040 0.001	0.001 0.000	0.002 0.000	0.001 0.000	0.021	282.321
< 1.50	1.444 0.007	0.090 0.002	0.002 0.000	0.004 0.000	0.001 0.000	0.020	282.321
< 1.75	0.742 0.004	0.048 0.001	0.001 0.000	0.002 0.000	0.001 0.000	0.018	282.321
< 2.00	0.661 0.005	0.044 0.001	0.001 0.000	0.002 0.000	0.001 0.000	0.019	282.321
< 2.25	0.463 0.005	0.032 0.001	0.001 0.000	0.004 0.000	0.001 0.000	0.019	282.321
< 2.75	0.120 0.003	0.007 0.001	0.000 0.000	0.002 0.000	0.001 0.000	0.019	282.321
3.75	0.106 0.002	0.005 0.000	0.000 0.000	0.001 0.000	0.001 0.000	0.019	282.321
7.00	2.617 0.010	0.007 0.001	0.004 0.000	0.002 0.000	0.009 0.000	0.018	282.321

Measured volumes are x 1E-10 cm3 NTP. **All errors are 2 x standard error.** **Intrim13 28-Mar-02**

Table DR2c. $^{40}Ar/^{39}Ar$ age spectra data for combined MMI96-17-4⁄4B Wr non-Mag + S.G.>2.85

Power	36Ar/40Ar	39Ar/40Ar	r	Ca/K	%40Atm	%39Ar	40Ar*/39K	Age
< 0.75>	0.002283±0.000517	0.022277±0.001248	0.017	2.209	67.41	0.06	14.61± 6.88	177.9± 79.8
< 1.50>	0.000616 0.000303	0.057159 0.001991	0.003	1.555	18.17	0.26	14.31 1.65	174.4 19.2
7.00>	0.002398 0.000203	0.017414 0.000657	0.018	0.699	70.81	0.14	16.74 3.50	202.5 40.1
< 0.50>	0.002729 0.000310	0.008130 0.000622	0.062	0.229	80.62	0.04	23.82 11.18	281.7 122.4
< 0.75>	0.002065 0.000365	0.031159 0.001469	0.009	0.330	60.96	0.11	12.51 3.52	153.4 41.3
< 1.00>	0.000846 0.000342	0.051404 0.001816	0.006	0.289	24.95	0.21	14.59 2.04	177.7 23.6
< 1.50>	0.000349 0.000163	0.062268 0.001452	0.002	0.372	10.29	0.47	14.40 0.85	175.5 9.8
< 1.75>	0.000381 0.000296	0.065629 0.001634	0.001	0.351	11.25	0.25	13.52 1.38	165.2 16.1
< 2.00>	0.000177 0.000325	0.067071 0.001813	-0.000	0.355	5.23	0.23	14.13 1.48	172.3 17.2
< 2.25>	0.000413 0.000515	0.071604 0.002674	0.001	1.057	12.18	0.17	12.26 2.18	150.5 25.7
< 2.75>	0.000749 0.002242	0.068030 0.005572	0.001	1.346	22.09	0.04	11.45 9.80	140.8 116.0
< 3.75>	0.001706 0.002306	0.056172 0.005098	0.006	1.855	50.33	0.03	8.83 12.18	109.6 146.6
7.00>	0.003100 0.000149	0.002412 0.000290	0.362	3.032	91.59	0.03	34.86 15.95	398.6 163.6
0.50	0.000823 0.000056	0.094854 0.001126	0.012	0.230	24.22	4.39	7.98 0.20	99.4 2.4
0.75	0.000102 0.000040	0.077062 0.000589	0.122	0.330	3.02	8.57	12.58 0.13	154.3 1.5
< 1.00	0.000100 0.000025	0.068421 0.000486	0.068	0.320	2.94	12.90	14.18 0.13	173.0 1.5
< 1.25>	0.000107 0.000022	0.067511 0.000456	0.043	0.310	3.16	17.36	14.34 0.13	174.8 1.5
< 1.50>	0.000122 0.000025	0.067968 0.000548	0.056	0.370	3.59	14.15	14.18 0.14	173.0 1.6
< 1.75>	0.000093 0.000028	0.068236 0.000502	0.093	0.350	2.74	13.51	14.25 0.13	173.8 1.5
< 2.00>	0.000113 0.000035	0.068868 0.000516	0.117	0.500	3.33	10.96	14.04 0.13	171.3 1.6
2.25	0.000126 0.000102	0.070338 0.000596	0.402	1.050	3.72	7.67	13.69 0.16	167.2 1.8
2.50	0.000266 0.000155	0.073506 0.000823	0.427	1.300	7.84	3.31	12.53 0.24	153.7 2.8
3.00	0.000272 0.000178	0.077172 0.000822	0.508	1.400	8.01	3.73	11.92 0.22	146.4 2.6
3.50	0.002057 0.000488	0.098871 0.002211	0.051	1.700	60.54	0.49	3.97 1.40	50.1 17.5
8.00	0.002147 0.001235	0.117689 0.003491	0.841	10.027	63.08	0.94	3.12 0.79	39.5 9.9

Power	40Ar	39Ar	38Ar	37Ar	36Ar	Blank 40Ar	Atmos 40/36
< 0.75>	0.510±0.004	0.011±0.001	0.001±0.000	0.003±0.000	0.002±0.000	0.019	282.321
< 1.50>	0.868 0.006	0.049 0.002	0.001 0.000	0.008 0.001	0.001 0.000	0.021	282.321
7.00>	1.557 0.009	0.027 0.001	0.002 0.000	0.002 0.000	0.004 0.000	0.020	282.321
< 0.50>	0.833 0.005	0.007 0.000	0.002 0.000	0.001 0.000	0.003 0.000	0.018	282.321
< 0.75>	0.679 0.005	0.021 0.001	0.001 0.000	0.001 0.000	0.002 0.000	0.019	282.321
< 1.00>	0.783 0.007	0.040 0.001	0.001 0.000	0.002 0.000	0.001 0.000	0.021	282.321
< 1.50>	1.444 0.007	0.090 0.002	0.002 0.000	0.004 0.000	0.001 0.000	0.020	282.321
< 1.75>	0.742 0.004	0.048 0.001	0.001 0.000	0.002 0.000	0.001 0.000	0.018	282.321
< 2.00>	0.661 0.005	0.044 0.001	0.001 0.000	0.002 0.000	0.001 0.000	0.019	282.321
< 2.25>	0.463 0.005	0.032 0.001	0.001 0.000	0.004 0.000	0.001 0.000	0.019	282.321
< 2.75>	0.120 0.003	0.007 0.001	0.000 0.000	0.002 0.000	0.001 0.000	0.019	282.321
< 3.75>	0.106 0.002	0.005 0.000	0.000 0.000	0.001 0.000	0.001 0.000	0.019	282.321
7.00>	2.617 0.010	0.007 0.001	0.004 0.000	0.002 0.000	0.009 0.000	0.018	282.321
0.50	8.758 0.019	0.827 0.010	0.018 0.001	0.003 0.000	0.009 0.000	0.016	293.402
0.75	20.989 0.021	1.611 0.012	0.023 0.001	0.004 0.000	0.004 0.000	0.018	293.402
< 1.00	35.564 0.046	2.423 0.017	0.032 0.001	0.005 0.000	0.006 0.001	0.017	293.402
< 1.25>	48.501 0.046	3.260 0.022	0.042 0.002	0.006 0.000	0.008 0.001	0.017	293.402
< 1.50>	39.270 0.057	2.658 0.021	0.035 0.002	0.006 0.000	0.008 0.001	0.018	293.402
< 1.75>	37.347 0.057	2.538 0.018	0.033 0.002	0.005 0.000	0.006 0.001	0.017	293.402
< 2.00>	30.015 0.045	2.059 0.015	0.027 0.001	0.005 0.000	0.006 0.001	0.018	293.402
2.25	20.569 0.030	1.442 0.011	0.020 0.001	0.005 0.000	0.006 0.001	0.018	293.402
2.50	8.505 0.020	0.624 0.006	0.011 0.001	0.005 0.000	0.005 0.000	0.019	293.402
3.00	9.138 0.020	0.704 0.006	0.013 0.001	0.005 0.000	0.006 0.000	0.018	293.402
3.50	0.958 0.005	0.095 0.002	0.005 0.001	0.005 0.000	0.005 0.000	0.018	293.402
8.00	1.528 0.007	0.180 0.002	0.010 0.001	0.005 0.000	0.007 0.000	0.018	293.402

J Value: 0.007094 ± 0.000024 **1.437 MSWD**
Can/Pos: 147/A51 **0.81 Mod. err.**
Mass: 1.0 mg
Volume 39K: 18.82 x 1E-10 cm3 NTP

Integrated Age: 164.65 ± 0.80 Ma

Initial 40/36: 314.71 ± 13.21 (MSWD = 1.02, isochron between 0.63 and 1.73)

Correlation Age: 173.04 ± 1.01 Ma (58.0% of 39Ar, steps marked by >)

Plateau Age: 173.25 ± 0.91 Ma (70.7% of 39Ar, steps marked by <)

Measured volumes are x 1E-10 cm3 NTP. All errors are 2 x standard error.

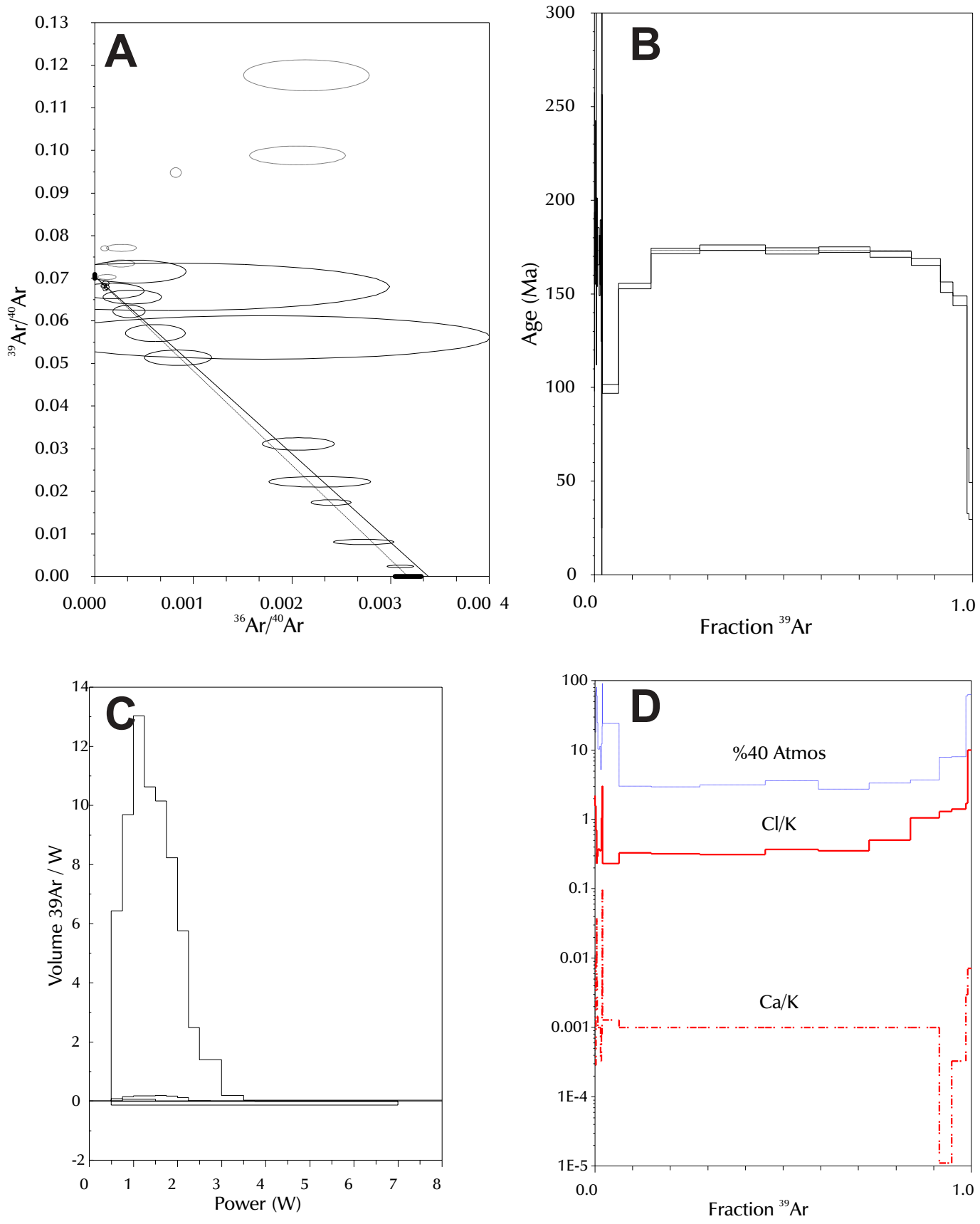

Figure DR3. Results for combined MMI96-17-4 and 4B non-magnetic and S.G.>2.85 fractions. (A) Correlation plot (duplicated from Fig. 7G), (B) $^{40}Ar/^{39}Ar$ age spectrum, (C) gas release spectrum, and (D) estimates of % atmospheric contamination.

Measured volumes are x 1E-10 cm^3 NTP. All errors are 2 x standard error.

TABLE DR3. U-Pb ANALYTICAL DATA

Fraction[1]	Wt	U[2]	Pb*	^{206}Pb	Pb[5]	^{208}Pb	Isotopic ratios (1σ, %)[7]			Apparent ages (2σ, Ma)[7]	
			[3]			[6]					
	mg	ppm	ppm	^{204}Pb	pg	%	$^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$	$^{207}Pb/^{206}Pb$
MMI96-17-7											
A c,N2,p	0.080	117	5	556	46	17.3	0.04170 (0.13)	0.2961 (0.59)	0.05150 (0.53)	263.4 (0.7)	263 (24)
B m,N2,p	0.088	110	5	1237	21	17.0	0.04137 (0.21)	0.2938 (0.40)	0.05151 (0.29)	261.3 (1.1)	264 (13/14)
C c,N2,p	0.142	85	4	194	178	16.0	0.04160 (0.21)	0.2956 (1.2)	0.05152 (1.1)	262.8 (1.1)	264 (48/50)
MMI96-16-3											
A cc,N2,p	0.244	363	9	9916	15	5.0	0.02631 (0.09)	0.1799 (0.16)	0.04960 (0.08)	167.4 (0.3)	176.1 (3.8)
B cc,N2,p	0.203	233	6	4554	17	4.6	0.02644 (0.10)	0.1807 (0.17)	0.04956 (0.11)	168.2 (0.3)	174.6 (5.0)
C c,N2,p	0.181	451	11	10375	13	4.6	0.02626 (0.10)	0.1794 (0.17)	0.04954 (0.08)	167.1 (0.3)	173.4 (3.8)
D m,N2,p	0.163	378	9	9966	10	5.3	0.02621 (0.11)	0.1790 (0.17)	0.04953 (0.09)	166.8 (0.4)	173.1 (4.3)
MMI96-2-11											
A cc,N2,p,s	0.228	292	8.0	5599	20	12.1	0.02668 (0.10)	0.1825 (0.17)	0.04961 (0.09)	169.8 (0.3)	176.8 (4.4)
B c,N2,p,e	0.148	259	7.1	1162	56	12.4	0.02678 (0.12)	0.1835 (0.26)	0.04968 (0.18)	170.4 (0.4)	180.3 (8.4)
C m,N2,p,e	0.196	300	8.2	4727	21	12.4	0.02645 (0.11)	0.1811 (0.18)	0.04966 (0.10)	168.3 (0.4)	179.3 (4.8)
D f,N2,p,e	0.115	266	7.3	3732	14	12.4	0.02662 (0.11)	0.1815 (0.18)	0.04946 (0.11)	169.4 (0.4)	169.9 (4.9)
T1 cc,N2,b	0.465	403	10	383	851	3.3	0.02656 (0.41)	0.1819 (1.07)	0.04967 (0.81)	169.0 (1.4)	179 (38)
T2 cc,N2,b	0.470	422	11	416	834	3.0	0.02687 (0.15)	0.1833 (0.50)	0.04950 (0.41)	170.9 (0.5)	171 (19)

Notes: Analytical techniques are listed in Mortensen et al. (1995).

[1] Upper case letter = fraction identifier; All zircon fractions air abraded; Grain size, intermediate dimension: cc = <180 μm and >134 μm, c = <134 μm and >104 μm, m = <104 μm and >74 μm, f = 74 μm. Magnetic codes: Franz magnetic separator side slope at which grains are nonmagnetic (N) or Magnetic (M); e.g., N1 = nonmagnetic at 1°; Field strength for all fractions = 1.8 A; Front slope for all fractions = 20°; Grain character codes: b = broken fragments, e = elongate, eq = equant, p = prismatic, s = stubby, t = tabular, ti = tips.

[2] U blank correction of 1-3pg ± 20%; U fractionation corrections were measured for each run with a double ^{233}U-^{235}U spike (about 0.005/amu).

[3] Radiogenic Pb

[4] Measured ratio corrected for spike and Pb fractionation of 0.0043/amu ± 20% (Daly collector) and 0.0012/amu ± 7% and laboratory blank Pb of 10 pg ± 20%. Laboratory blank Pb concentrations and isotopic compositions based on total procedural blanks analysed throughout the duration of this study.

[5] Total common Pb in analysis based on blank isotopic composition

[6] Radiogenic Pb

[7] Corrected for blank Pb, U and common Pb. Common Pb corrections based on Stacey Kramers model (Stacey and Kramers, 1975) at the age of the rock or the $^{207}Pb/^{206}Pb$ age of the fraction.

Table DR4. Ammonite age determinations from the Lisadele Lake area

Field Number	Location	Fauna	Age
GJ094-41-8 GSC C208234	Bug Pk.	*Protogrammoceras paltum*, *Fieldingiceras fieldingii* ?, *Lioceratoides* sp., *Arieticeras* ?,sp. Comments: Numerous specimens of complete and fragmentary ammonites. Poorly- to well-preserved.	Upper Pliensbachian-Carlottense Zone
GJ094-41-9 GSC C208235	Bug Pk.	*Dactylioceras kanense* ?, *Dactylioceras* spp., *Taffertia tafferentis ?, Protogrammoceras paltum* ?, *Ovaticeras* ? sp. Comments: ten specimens of poorly- to well-preserved whole and fragmentary ammonites.	Lower - base? of Kanense Zone
GJ094-4 1 -10 GSC C208237	Bug Pk.	Ammonite gen. et sp. indet. Comments: one large moderately preserved ammonite fragment. Collected from talus 300 m. SE. of GJ094-41-9 (L. Toar.) from similar stratigraphic level.	Lower ? Toarcian ?
GJ094-42-5 GSC C208238	Lisadele Lk.	*Arieticeras* sp., *Fuciniceras* ? sp., *Protogrammoceras* ? sp. Comments: five complete and fragmentary ammonites. Poorly- to well-preserved.	Upper Pliensbachian
GJ094-42-12	Lisadele Lk.	*Protogrammoceras paltum* ? Comments: two moderately- to well-preserved fragments.	Upper Pliensbachian-probable Carlottense Zone
GJ094-43-1 GSC C208239	Lisadele Lk.	*Dactylioceras* sp., *Hildaites* cf. *murleyi* Comments: four moderately-preserved ammonite fragments.	Lower Toarcian - Kanense Zone
GJ094-43-1-2 GSC C208240	Lisadele Lk	Ammonite gen. et sp. indet. Comments: seven poorly- to moderately-preserved whole and fragmentary ammonites. Collected - 80 m. upsection from GJ094-43 I (Lower Toarcian).	Lower ? Toarcian
GJ094-43-3 GSC C208241	750m S of Lisadele Lk.	*Pseudolioceras* cf. *lythense* Two specimens: moderately-preserved whole ammonite + small fragment. Associated with 'metamorphic' conglomerate.	Middle Toarcian-possibly upper Planulata Zone
GJ094-43-6 GSC C208242	1km WSW of Lisadele Lk.	*Podogrosites latescens* Comments: one very well-preserved whole ammonite. Associated with 'metamorphic' conglomerate.	Upper Toarcian-Hilldebrandti Zone

GJ094-44-2	Lisadele Lk.	*Tiltoniceras antiquum, Arieticeras* sp., *Lioceratoides* spp.	Upper Pliensbachian-
GSC C208243		(including *L grecoi ?), Protogrammoceras paltum ?, Lioceratoides (Pacificeras)* spp., *Fieldingiceras ?* sp. Comments: numerous specimens of complete and fragmentary ammonites. Poorly to well-preserved.	Carlottense Zone
GJ094-44-3	Lisadele Lk.	*Leptaleoceras accuratum, Amaltheus stokesi ?, Protogrammoceras* spp., *Fanninoceras ?* sp. Comments: missing collection. Fauna listed are from field identifications and cannot be verified but are certainly Upper Pliensbachian (e.g. *Amaltheus sp.).*	Upper Pliensbachian- Kunae Zone
GSC C *N/A*			
CHA94-46-1		*Metaderoceras ?* sp., *Weyla bodenbenderi ?, Vaugonia* sp., belemnoid Comments: five moderately- to well-preserved fragmentary specimens (includes 2 ammonites).	Lower ? Pliensbachian
GSC C211256			
MM194-19-8	3km SSW of	*Chondroceras* cf. *allani, Chondroceras defontii ?,* Ammonite gen. et sp. indet. Comments: numerous specimens of moderately to well-preserved fragmentary ammonites. Associated with 'chert' conglomerate.	latest Lower Bajocian
GSC C211248	Lisadele Lk.		
MM194-20-6	7km SW of	*Tiltoniceras antiquum ?,* Protogrammoceras spp., *Fontanelliceras* sp., *Lioceratoides* sp. Comments: numerous specimens of complete and fragmentary ammonites. Poorly- to well-preserved.	Upper Pliensbachian- Carlottense Zone
GSC C211249	Lisadele Lk.		

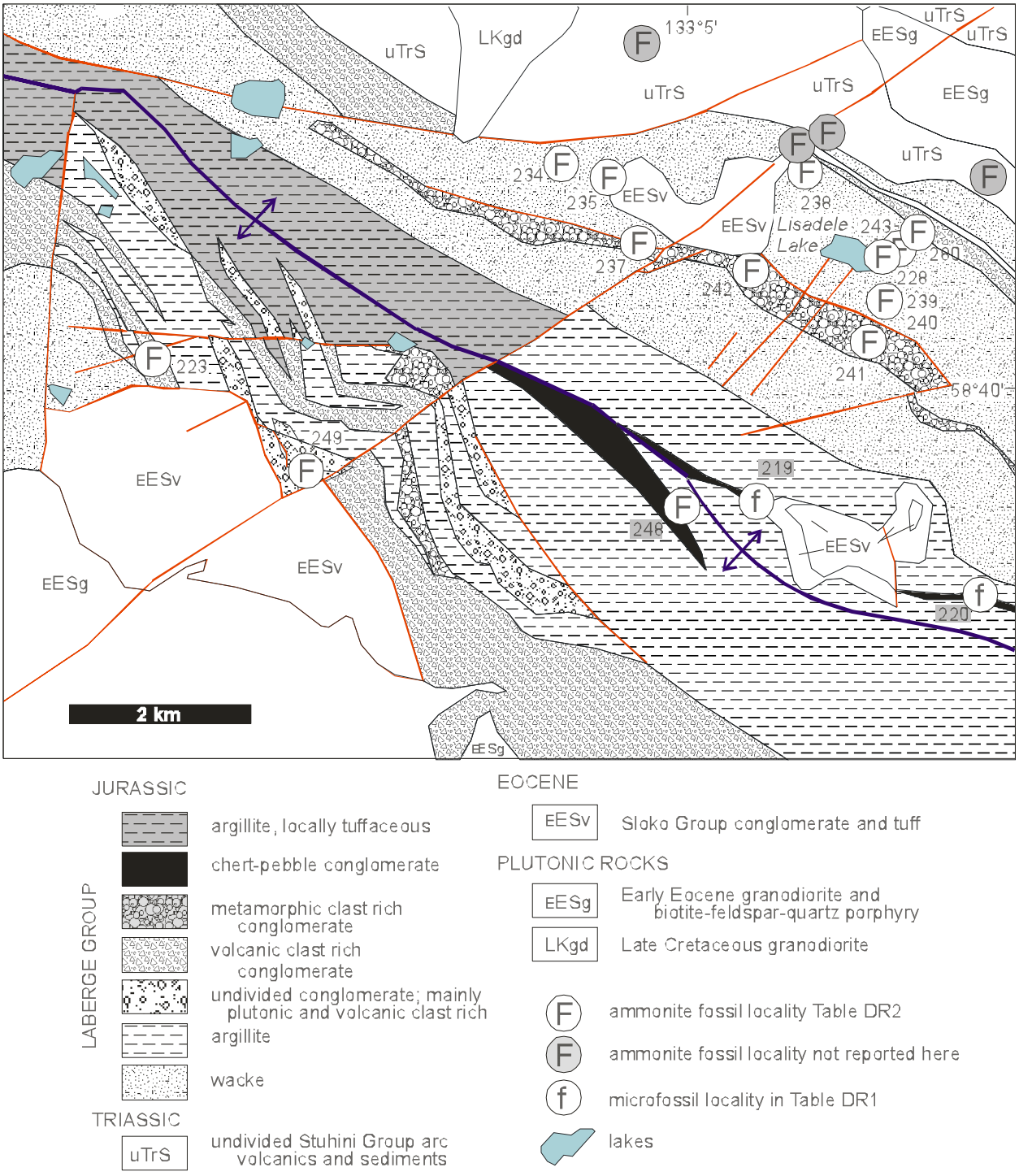

Figure DR3. Simplified regional geology of the Lisadele Lake area, after Mihalynuk et al. (1995b). Ammonite and radiolarian sample sites are shown. Three digit numbers adjacent the site localities correspond to the last three digits of the GSC – series numbers in tables DR1 and DR4.