Energy, Mines and Resources Canada
Geological Survey of Canada
100 West Pender, Vancouver
V6B 1R8

Énergie, Mines et Ressources Canada
Commission géologique du Canada
100, ouest, rue Pender, Vancouver
V6B 1R8

675857

94m/14

18 December, 1984

Your file Votre référence

Our file Notre référence

John Carter
Dresser Minerals
#300 - 407-2nd St. S.W.
Calgary, Alberta
T2P 2Y3

Dear John:

On a separate sheet I have listed the results of S isotope analyses on the barite specimens you forwarded to me in 1983 and 1984. You may be interested in comparing your data with some unpublished GSC data of mine (DY sample numbers) and Ian Jonasson and Wayne Goodfellow. I have plotted most of these data on the accompanying S isotope age curve from Claypool et al. (1980). You will note that most barite deposits, including your BEAR, MOOSE, BEAVER suite, plot well to the right of Claypool's curve.

A new S isotope age curve, based specifically on exhalative barites in the northern Cordillera, has been constructed by Jonasson and Goodfellow (CIM Sp. Vol: 'Mineral Deposits of the Northern Cordillera', in press). They found consistently higher $\delta^{34}S$ concentrations in barites exhaled in anoxic seafloor sub-basins, than those published by Claypool derived from evaporitic deposits in shallow oxygenated littoral zones of the same age.

On the Jonasson-Goodfellow curve, your BEAR, etc. barites are similar in isotopic weight to the stratiform exhalative barites of the Gatataga-Akie belt (CIRQUE, ELF) of late Devonian (Frasnian) age. The proximity of shale-hosted barite deposits to epigenetic carbonate-hosted deposits suggests a genesis analagous to the Beales-Jackson model of the provenance of carbonate-hosted PbZn in adjacent shale basins.

Your BILL-CARLICK specimen compares closely to my Atan L. specimen from Tournagain Mining's deposit nearby. Both appear to be derived from Cambrian sediments rather than granite.

The South Ewen specimen has a S-isotope composition very similar to that defined by Claypool for early Miss. seawater sulphate, and also plots on Jonasson's curve close to other early Miss. barites.

Your Larrabee Falcon specimen from Horsethief Ck, BC corresponds to either a latest Proterozoic or Middle Cambrian age on the curve; the former corresponding more closely to the host rock age as I understand it. A stratiform syngenetic origin appears acceptable.

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John Carter 18 December, 1984

If any further questions of interpretation arise, please give me a call. Thank you very much for your interest, and for providing specimens for analysis.

I'm looking forward to a visit to the Fireside operations next summer. Do any maps or reports exist for the deposit?

Best regards,

Ken Dawson

KD/bv

Encl.

John Carter Barite Specimens for S Isotope Analyses

No.	Name	Description	$S^{34}S$‰ $\pm$0.5‰
DY2885	MOOSE	S. end deposit outcrop. 127°15'W 59°45.5'N	+30.43
DY2887	MOOSE	S. area, outcrop. PbS present rerun	+35.99 +36.52
DY2891	MOOSE	coarse crystalline, grey	+37.57
DY2888	BEAR	DDH 72-4:106'(?) coarse crystalline	+35.69
DY2889	BEAVER	Near Moose. Lat/Long unknown	+37.94
DY2890	BILL - CARLICK	Atan L. 104P/3 129°13.5'W;59°12.5'N Pale buff crystalline replacement in Atan limestone	+34.41
DY2892	LARABEE FALCON	Horsethief Ck., Invermere, B.C. 50°27'15"N;116°06'W	+30.01
DY2893	S. EWEN	DDH EB-82-1; 104 0/16 130°13'W; 59°59'N	+23.96

GSC Barite Specimens Analyzed For S Isotopes

No.	Name, location	$S^{34}S$‰ ± .5‰
DY2578	Liard fluorospar 94M/8 59°32'N; 126°05'W e-mDev Dunedin Fm.	+31.09
DY2562	110 Creek barite-fluorite, Summit L. 58°42'N; 124°47.5'W Stone/Dunedin Fims.	+29.98
DY2563	110 Ck	+34.09
DY2564	110 Ck	+36.72
DY2565	110 Ck	+32.72
DY2567	MUN barite; Muncho L. 94N/04 59°06'N 125°41'W Host e-m Dev Stone Fm.	+26.97
DY2569	MUN	+25.06, 24.68
DY2570	MUN	+25.34
DY2571	MUN	+27.26
DY2894	ATAN L. Tournagain M.L. Crystalline +PbS, ZnS, $CuFeS_2$, FeS_2, 104P/4 59°12'N; 129°12W	+32.64
LEA 380	MEL (Otter Ck) 95D/06 PbZnBa	+39.34
LEA 378	MEL 60°21'N; 127°24'W	+38.9
LEA 382	MEL	+36.37
94F.CRQU 7902	CIRQUE 94F/11 PbZnAgBa	+43.2
94F.CRQU 7901	CIRQUE	+39.2
DY2555	ROMAN-NAZO 105A/2 In Liard Canyon 5 mi SE of Watson Lake. Veins in black shale	+36.09
DY2605		+34.08
DY2606		+35.26

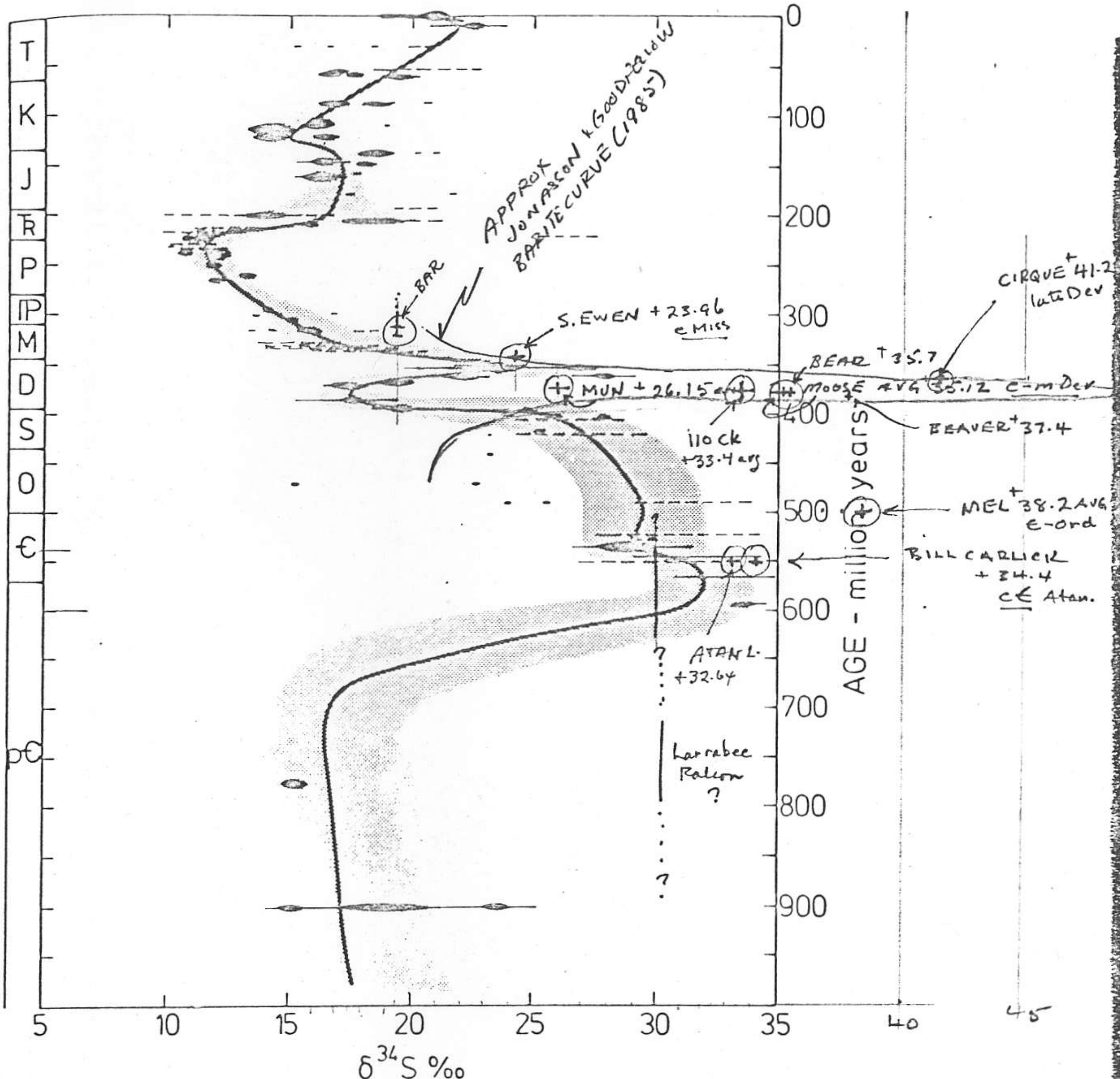

Fig. 9. Summary sulfur isotope age curve for sulfate. All data from our work, and most of those published elsewhere (for references see Figs. 4—8) are shown as *solid areas* or *lines* that qualitatively indicate the number of analyses, plotted at their most probable age. Horizontal *dashed lines* signify the range of relatively few analyses. The *heavy line* is our best estimate (see text) for $\delta^{34}S$ of sulfate mineral in equilibrium with the world ocean surface sulfate of that date. The *shaded area* is our estimate of the uncertainty of this curve.

With authors' compliments

Chemical Geology, 28 (1980) 199–260

THE AGE CURVES OF SULFUR AND OXYGEN ISOTOPES IN MARINE SULFATE AND THEIR MUTUAL INTERPRETATION*[1]

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ABSTRACT

Claypool, G.E., Holser, W.T., Kaplan, I.R., Sakai, H. and Zak, I., 1980. The age curves of sulfur and oxygen isotopes in marine sulfate and their mutual interpretation. Chem. Geol., 28: 199–260.

Three hundred new samples of marine evaporite sulfate, of world-wide distribution, were analyzed for $\delta^{34}S$, and 60 of these also for $\delta^{18}O$ in the sulfate ion. Detailed $\delta^{34}S$ age curves for Tertiary–Cretaceous, Permian–Pennsylvanian, Devonian, Cambrian and Proterozoic times document large variations in $\delta^{34}S$. A summary curve for $\delta^{18}O$ also shows definite variations, some at different times than $\delta^{34}S$, and always smaller. The measured $\delta^{34}S$ and $\delta^{18}O$ correspond to variations in these isotopes in sulfate of the world ocean surface. The variations of $\delta^{18}O$ are controlled by input and output fluxes of sulfur in the ocean, three of which are the same that control $\delta^{34}S$: deposition and erosion of sulfate, and deposition of sulfide. Erosion of sulfide differs in its effect on the S and O systems. $\delta^{18}O$ in the sulfate does not seem to be measurably affected by equilibration with either seawater or with subsurface waters after crystallization. In principle, the simultaneous application of both $\delta^{34}S$ and $\delta^{18}O$ age curves should help reduce the number of assumptions in calculations of the cycles of sulfur and oxygen through geological time, and a new model involving symmetrical fluxes is introduced here to take advantage of the oxygen data. However, all previously published models as well as this one lead to anomalies, such as unreasonable calcium or oxygen depletions in the ocean–atmosphere system. In addition, most models are incapable of reproducing the sharp rises of the $\delta^{34}S$ curve in the late Proterozoic, the Devonian and the Triassic which would be the result of unreasonably fast net sulfide deposition. This fast depletion could result from an ocean that has not always been mixed (as previously assumed in all model calculations).

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