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FILE NOTE

FROM : PROJECT GEOLOGIST (Keith Hannan) May 15th, 1992
TO : PRINCIPAL GEOLOGIST (Ken Maiden)
SUBJECT : DISTRICT OXYGEN ISOTOPE WORK

A DISCUSSION OF ISOTOPE DATA FROM THE NW LAKES AREA

Introduction

Dolomite stable isotope data is available for recently drilled Mount Isa Group rocks (DDHs LA004 and 007) near the Spillway Fault area at Lake Moondarra (see Fig.1). This File Note reviews the new data, as well as earlier results from both the northwest and southern Lake Moondarra areas (Waring, 1991).

Conclusions

(1) A review of the isotope data from the NW Lakes area indicates that the $\delta^{18}O$ gradient in Urquhart Shale adjacent to the Spillway Fault is much steeper than that observed at Mount Isa Mine. If large zones of $\delta^{18}O$ depletion (and by analogy with Mount Isa, copper deposits) are associated with the Spillway Fault, then they probably occur at depths of more than 1000 to 1500m below the surface.

(2) A combination of areally restricted surface copper anomalies and steep oxygen-isotope gradients suggests that the potential for economic mineralisation at depth in the *eastern* Spillway Fault area has been adequately tested.

(3) Potential still remains for a relatively small but high grade copper deposit in the *western* Spillway Fault area (below 500m).

(4) The data from a single drillhole from *southern* Lake Moondarra (DDH Ei 211) is discouraging; either no depletion has occurred, or the area lies above a very large depletion zone with ore at more than 2km depth.

New Isotope Data - Western Spillway Fault area

Sampling procedure

Individual core specimens (10-20cm long) were sampled at approximately 50m intervals along each drillhole (Fig.2). The two analyses at 440m along DDH LA007 correspond to samples prepared according to the Waring method (1-2m of core, bulked) and Hannan method (0.1-0.2m core, bulked). Evidently the two methods produce similar results. Given the well-defined trend of $\delta^{18}O$ depletion with depth in both LA4 and LA7 (and DDH V334; Hannan,1991), the small sample approach seems quite adequate for the characterisation of isotope trends in drill core.

DDHs LA004 and LA007

Sufficient data is available from these drillholes to confidently quantify any downhole trends in dolomite $\delta^{18}O$ values (see Fig.2). Values decrease along LA004 from about 19 per mil at 80m to 13 per mil at 230m downhole, indicating a gradient of about 3.8 per mil per 100m (*i.e.*, $grad_{ox}$ = 3.8). Similar treatment of the LA007 data yields $grad_{ox}$ = 1.9. These gradients are two to four times higher than those observed at Mount Isa Mine ($grad_{ox}$ generally less than 1). This observation, the absence of wholerock $\delta^{18}O$ values of less than 13 per mil, and a lack of significant copper mineralisation within 100m of the Spillway Fault indicate that the hydrothermal system responsible for alteration at this locality was relatively small. It is pointed out, however, that the LA007 data do not preclude the possibility of a small, say 0.5 million tonne (metal), copper deposit at depth. In this regard, the LA007 results are the most encouraging of the Lake Moondarra area, both in terms of $\delta^{18}O$ patterns and copper analyses (see Table 1 overleaf).

<u>Comment on $\delta^{13}C$ values</u>

It is interesting to note how $\delta^{13}C$ values from the western Spillway Fault area are consistently elevated compared to other *mineralised* areas of the region (small filled circles of Fig.3). It is probable that these values indicate local derivation of carbon from wallrock carbonate, and that the fluids had not reacted with significant quantities of carbonaceous sediment before infiltrating the Urquhart Shale at this location.

By contrast, $\delta^{13}C$ values of Spear Siltstone rocks from the eastern part of the Spillway Fault (see Fig.1 and Figs 4b and 5a) are consistently less than -2 per mil, possibly indicating the influence of local carbonaceous units in the Spear Siltstone, or

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these $\delta^{13}C$ values were subject to a calculation error (UQ) – they should all be about 1.5‰ lighter (see amended data from SDGolding)

doesn't drastically Δ KWH interpn viz local derivation perhaps the infiltration of small volumes of Isa Mine-type brine (in terms of $\delta^{13}C$).

The $\delta^{13}C$ patterns of the NW Lakes area lend support to an earlier conclusion that local wallrock carbon controls hydrothermal carbonate $\delta^{13}C$ values in areas of *limited* fluid-rock interaction (Hannan, 1992). Accordingly, the western Spillway Fault area $\delta^{13}C$ data is a further negative attribute if the analogy with Mount Isa Mine (with similarly ^{18}O-depleted dolomite) is appropriate.

TABLE 1. SUMMARY OF COPPER ASSAYS FOR SOME NW LAKES DIAMOND DRILLHOLES

DDH	Best Cu (%)	Downhole depth	Comment
TG476	0.5	222.5-234.0	no other splits with with >0.02%
	0.05	449.5-466.8	
Cl505	0.1	222-225	scattered splits with between 0.01 and 0.1% Cu
	0.25	507-510	
	0.05	555-580	
Eh478	0.41	388-394	very few other splits with >0.01%
	0.49	921-924	
Fh486	0.07	356-358	as above
	0.13	412-416	
	0.23	542-544	
La004	0.07	268-270.5	no other splits with >0.02% Cu
La007	0.2	451-465	commonly 0.01-0.1% between 423-479m

Waring Data (1990-1991)

Moondarra south (not shown on Fig.1)

Little or no $\delta^{18}O$ depletion is observed in over 500m of Urquhart Shale along DDH Ei211 (see Fig.4a). The consistent values of between 17.8 and 18.7 per mil are rather difficult to interpret as they straddle the lower boundary of values expected of pristine Proterozoic marine carbonate (see shaded box of Fig.3). If these data correspond to hydrothermal carbonate, then the target must be very large *but* also very deep (more than 1km and possibly more than 1.5km deep).

A perusal of drill logs revealed that the sediments transected by Ei211 are not deformed (folded, sheared or obviously foliated) compared to those transected by other holes near the Spillway Fault (*e.g.*, DDHs Ci505 and TG476). Furthermore, veins along DDH Ei211 are calcite- rather than dolomite-bearing, and it seems the core appeared barren enough to discourage base-metal analysis. These observations suggest that the isotope analyses correspond to pristine carbonate and that the relationship of the isotope profile to the un-named fault of Fig.4a is probably similar to that observed further north adjacent to the Spillway Fault (*e.g.*, Fig.5b).

Stone Axe area (eastern Spillway Fault)

The data for DDH Ci505 are unusual because $\delta^{18}O$ values appear to increase towards the Spillway Fault (Fig.4b). This pattern is almost certainly an artifact because the two samples furtherest from the Spillway Fault ($\delta^{18}O \approx 12$ per mil) correspond to vein dolomite rather than wallrock or wallrock-dominated dolomite. These depleted vein samples were probably hosted by wallrocks with $\delta^{18}O \approx 18$ per mil (*c.f.*, Fig.4a and Fig.5); if so, they indicate considerable vein-wallrock disequilibrium. This observation, together with the relatively strong depletion and only minor copper mineralisation (*e.g.*, 4m at 0.7% on the Spillway Fault, see also Table 1), suggest that Mount Isa Group rocks at this locality were pervasively infiltrated by an externally derived, ^{18}O-depleted, but essentially non-mineralising fluid.

Central Spillway Fault area

16000mE

The data from drillholes Eh478 and Fh486 indicate a *minimum* $\delta^{18}O$ gradient of 1.7 per mil per hundred metres (see Fig.5a). Despite the deformation and veining of rocks in this area, copper assays are also dissapointing (Table 1). Thus, the area seems to have low potential for significant mineralisation.

16500mE

If the isotope contours drawn through the traces of DDHs Vg436 and Tg476 (Fig.5b) are representative, then the conclusion reached for drillholes on the 16000mE section also applies to this section. The lack of $\delta^{18}O$ variation, over 1000m vertically (at approximately the same stratigraphic level within the Urquhart Shale), throughout Vg436 indicates that $\delta^{18}O$ depletion remains confined to the immediate vicinity of the Spillway Fault at depth.

References

Hannan, K.W., 1991, Discussion of oxygen-isotope data from DDH V334 (Isa Mine): MIMEX File Note, 19/04/91, 9pp (includes diagrams).

Hannan, K.W., 1992, A discussion of mineralisation at Bloodwood Bore: MIMEX File Note, 07/04/92, 9pp (includes 4 diagrams).

Waring, C.L., 1991, Carbonate isotope and major element geochemical exploration technique: Report to MIMEX, 22/11/91, 41pp. plus cross-sections and appendices.

cc. P.Forrestal, P.Pearson, W.Perkins, R.Buckland, N.Leggo, N.Sheard

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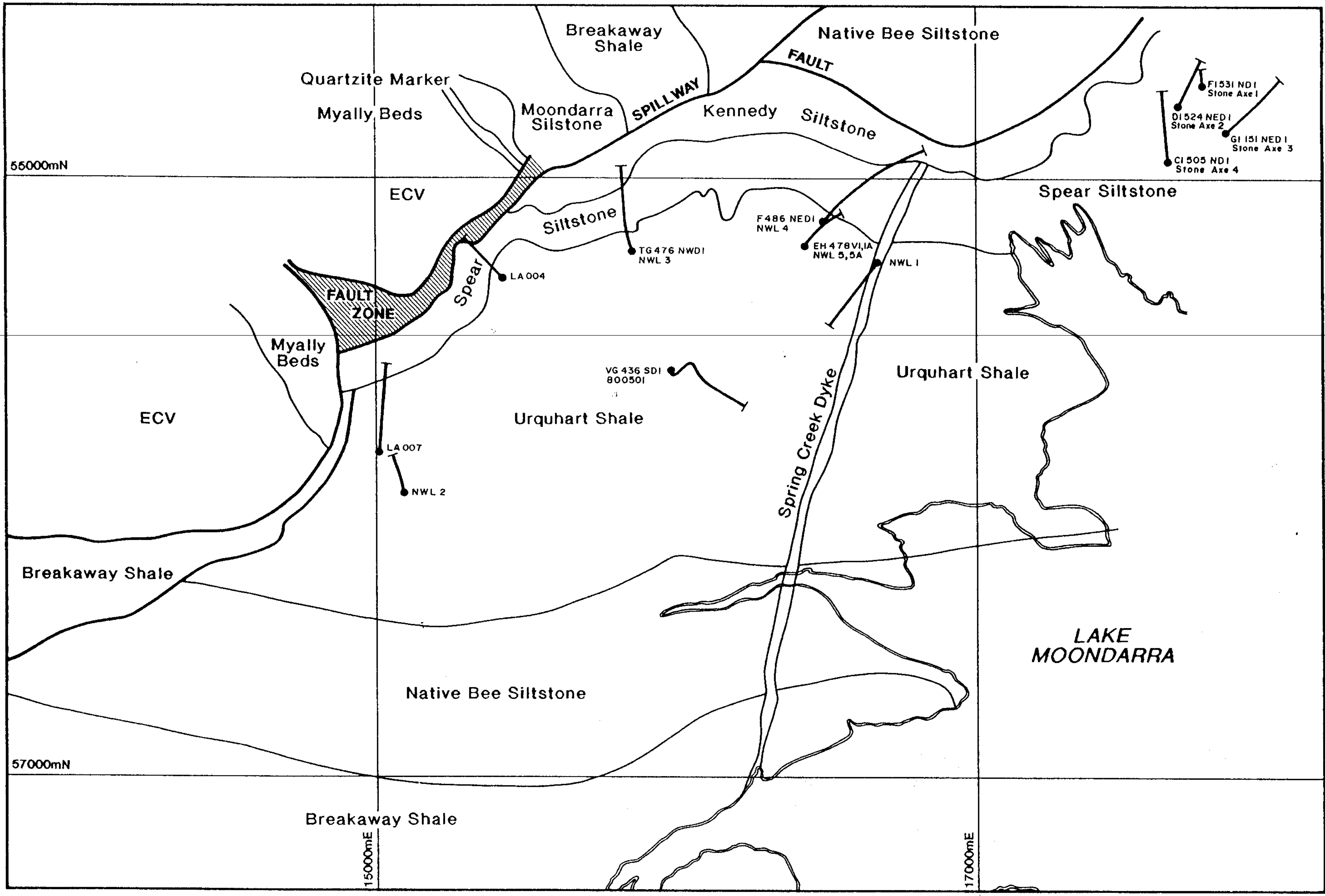
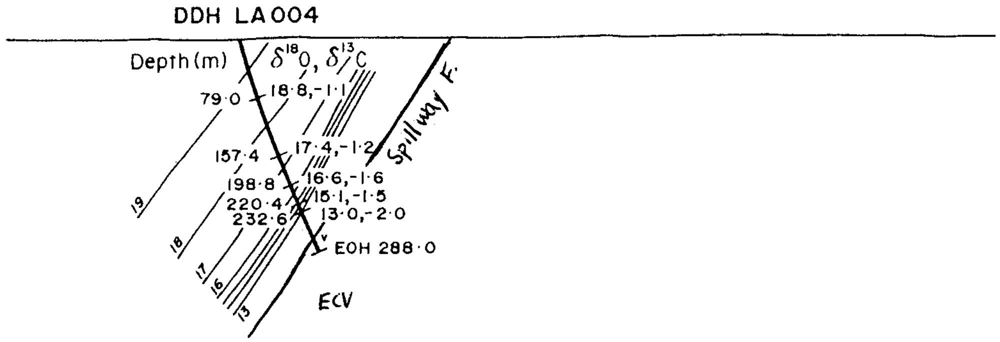
Figure 1.



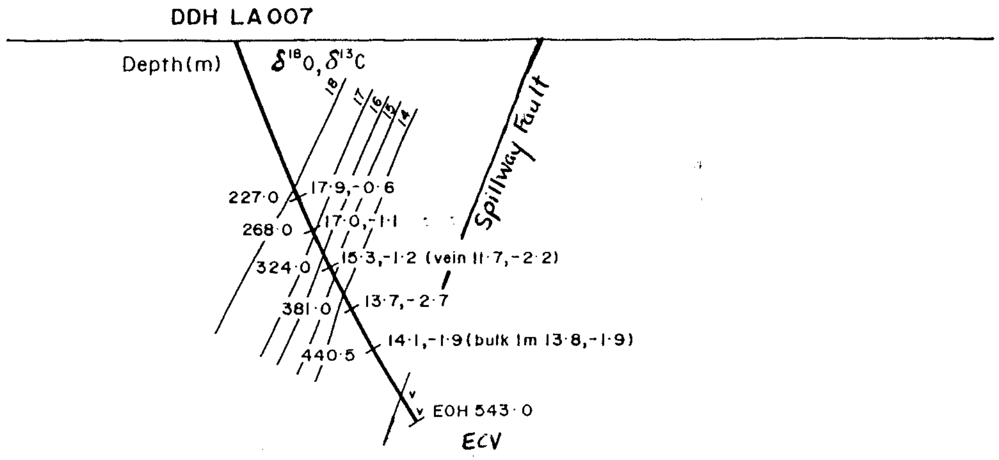
GEOLOGICAL MAP OF THE NORTH-WEST LAKE MOONDARRA AREA SHOWING DRILL HOLE TRACES

ISA/5304

Figure 2.



All core above ECV logged as Spear-Kennedy Siltstone



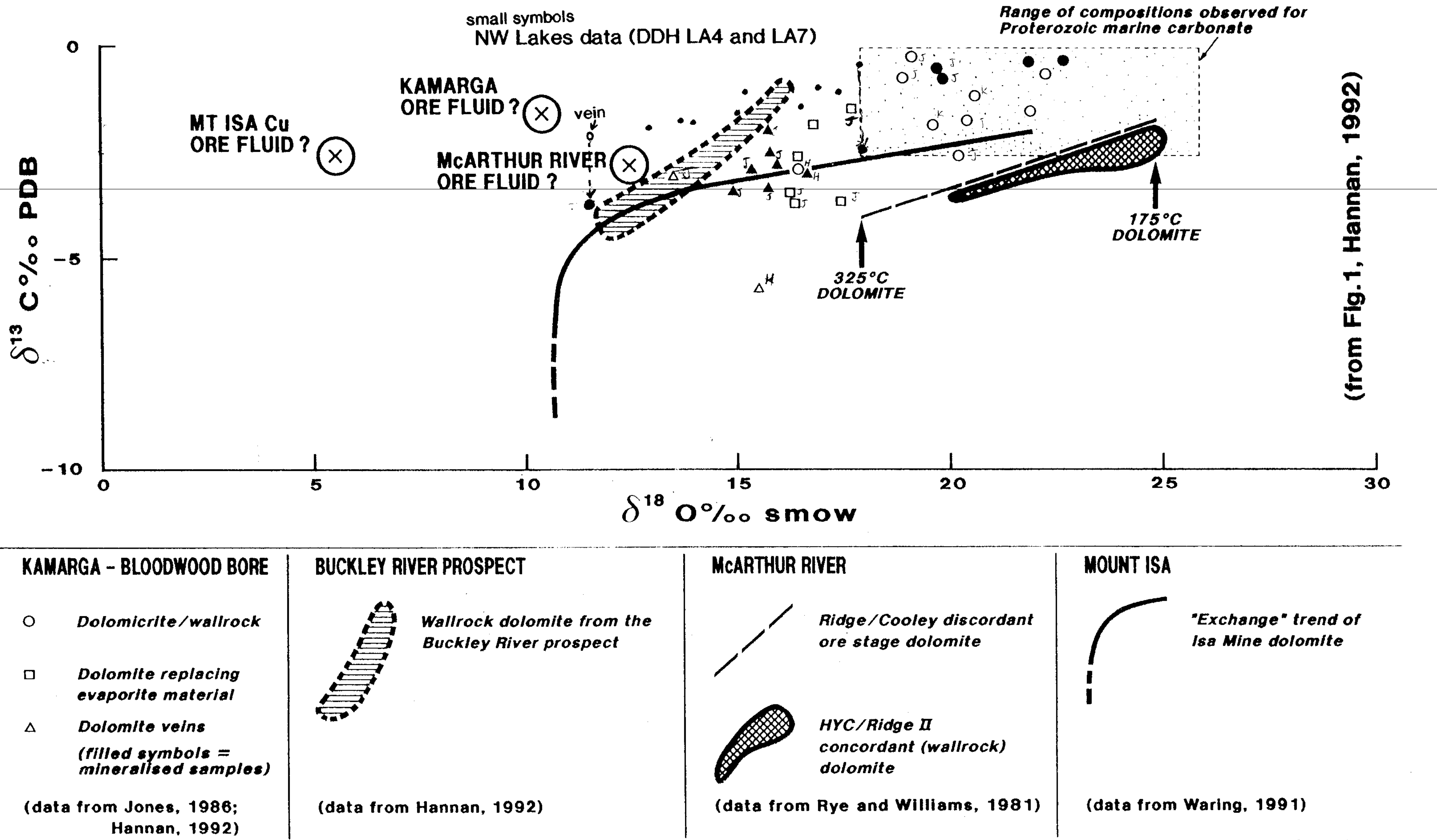
All core above ECV logged as Urquhart Shale

DOLOMITE $\delta^{18}O$ - $\delta^{13}C$ VALUES FROM WESTERN SPILLWAY FAULT AREA

SCALE: 1:1000

ISA/5305

Figure 3. STABLE ISOTOPIC COMPOSITIONS OF DOLOMITE AND ORE FLUIDS FOR DEPOSITS FROM THE MOUNT ISA - LAWN HILL - McARTHUR RIVER REGION

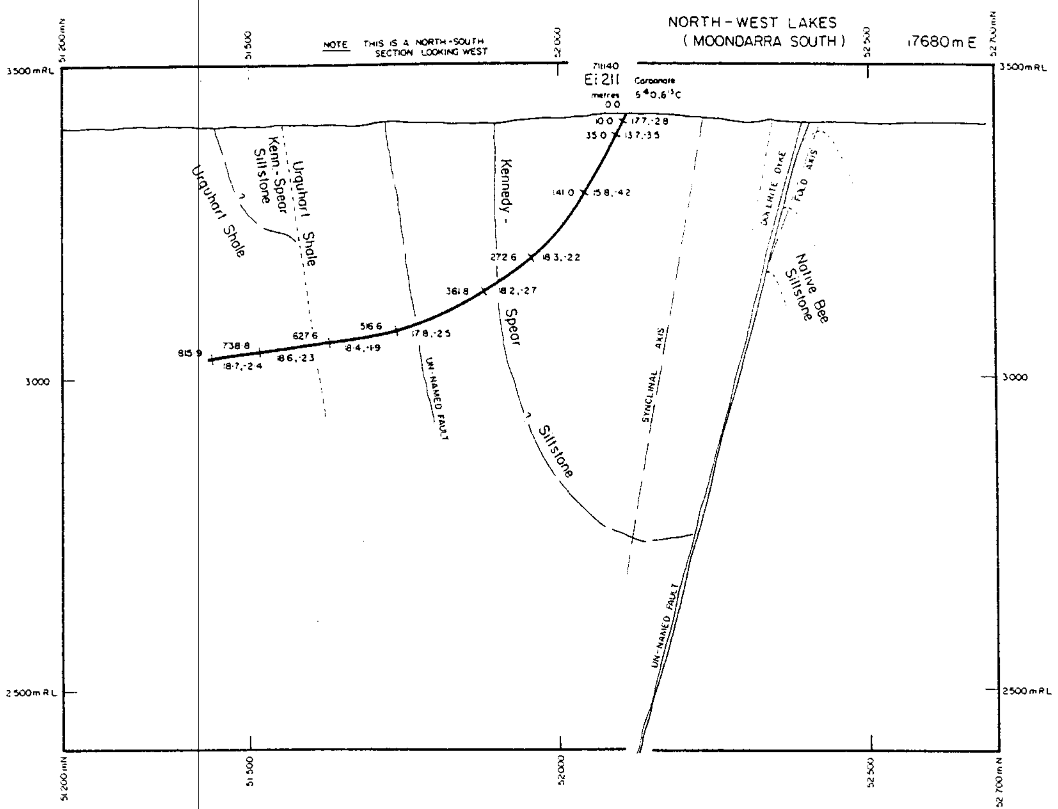


Drg. No. ISA/10071

8/12/92) Need to ADD BB003 → BB001

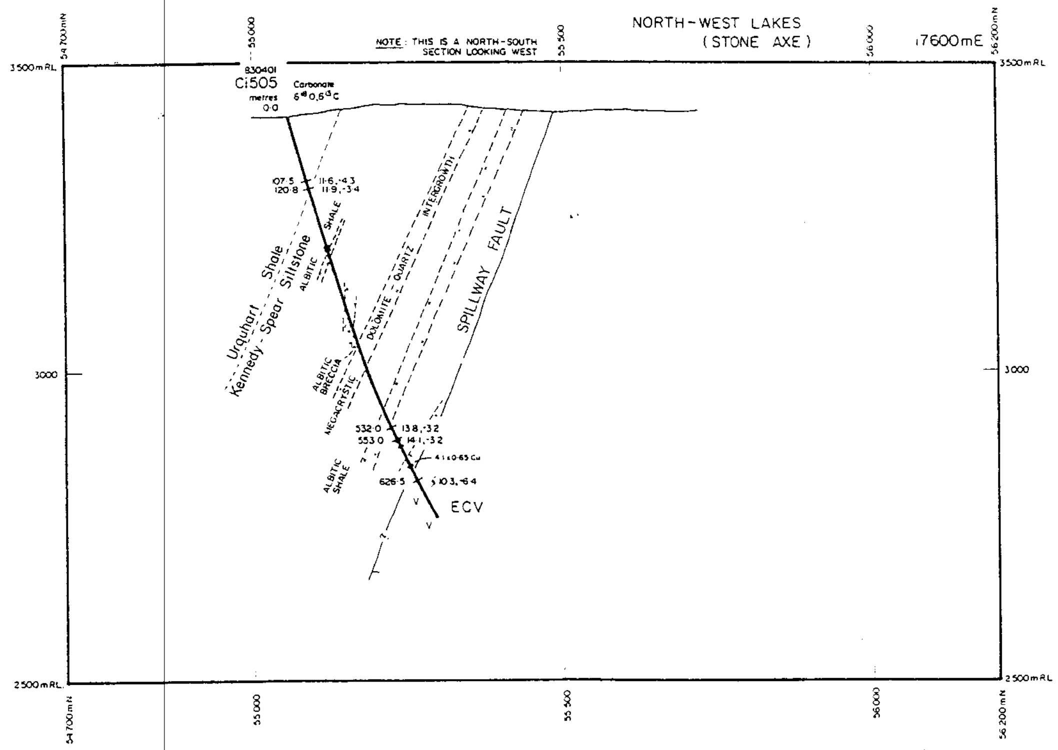
---> correct $\delta^{13}C$ for NWL data

4A



(These Diagrams taken from Waring, 1991)

4B

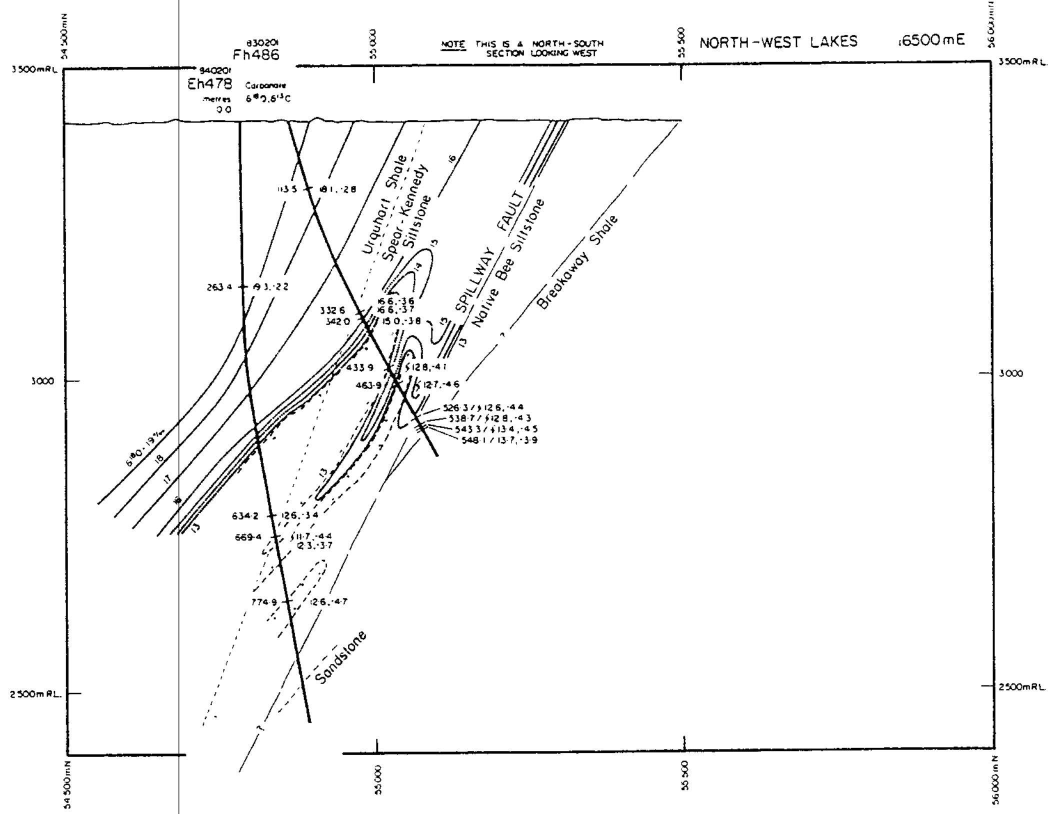


GeoSphere

DOLOMITE $\delta^{18}O$ - $\delta^{13}C$ VALUES FROM EASTERN SPILLWAY FAULT AND SOUTHERN LAKE MOONDARRA AREAS

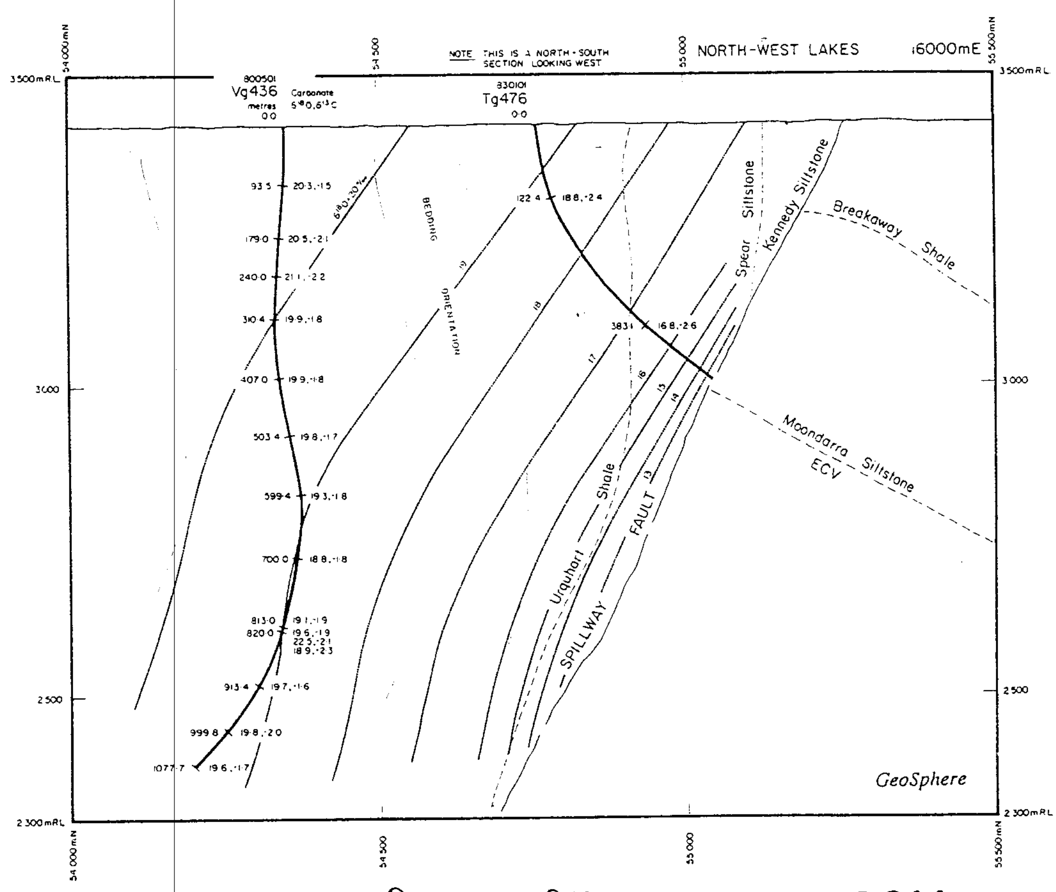
Figure 4.

A



(These Diagrams taken from Waring, 1991)

B



DOLOMITE $\delta^{18}O$ – $\delta^{13}C$ VALUES FROM CENTRAL SPILLWAY FAULT AREA

Figure 5.