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FN4

SCAN to update isot. digital files

APRIL 19, 1991

FILE NOTE

NOTE TO : PRINCIPAL GEOLOGIST (KJM) - TARGET GENERATION (N.W.Q.)

FROM : PROJECT GEOLOGIST (KWH) - TARGET GENERATION (N.W.Q.)

TITLE : DISCUSSION OF OXYGEN-ISOTOPE DATA FROM DDH V334

SUBJECT : OXYGEN ISOTOPE DEPLETION AND COPPER MINERALISATION

INTRODUCTION

As an extension to the DDH V334 Project (Hannan, 1991), 25 specimens of vein and wall rock carbonate were analysed for $\delta^{18}O$ and $\delta^{13}C$ to:

(a) determine wall rock dolomite $\delta^{18}O$ values for shale some 200m vertically above the highest (R.L.) previously analysed Isa Mine samples;

(b) test the degree of isotopic equilibrium in dolomite from vein and wall rock pairs, progressively away from the lobe of copper ore and silica-dolomite at the bottom of DDH V334.

The results are presented and discussed herein. The total cost of analysis was about $2200.

CONCLUSIONS

1. There is strong evidence from an 800m long, vertical drill hole above the southern 1100 copper orebody, that vein-wall rock carbonate is in isotopic equilibrium well beyond silica-dolomite, and that vein-wall rock equilibrium extends to the surface in sporadically veined Urquhart Shale.

2. Small fossil hydrothermal systems should display steep isotope gradients and vein-wall rock isotopic disequilibrium. However, gradients determined from wall rock samples for some outlying prospects are similar to that observed along DDH V334 (*i.e.*, less than 1‰ per 200m, downhole). These areas may display wall rock-vein disequilibrium but few vein analyses are available to compare with wall rock analyses.

3. Stable isotope-based assessments of new targets will probably be enhanced if veins, as well as wall rocks, are examined at the scout drilling stage.

4. Unless visibly leached and/or oxidised, surface and near surface carbonate samples will probably yield isotope analyses unaffected by surface processes.

RECOMMENDATION

Several drill holes should be reexamined to determine the degree to which vein and wall rock carbonate have isotopically equilibrated. Priority drill holes are listed at the end of this note.

RESULTS

Except for one specimen, all the data summarised in Figure 1 are for dolomite samples extracted from veins and wall rock Urquhart Shale. Wall rock samples are unveined portions (<10cm of core) of shale sampled immediately next to the corresponding vein samples. Photographed core, with marked sample sites, and a detailed log of the drill core are available in the C.E.C. Technical Report 1573 (Hannan, 1991).

Three important features are evident in Figure 1:

(a) isotope analyses of dolomite from partially weathered shale within 50m of the surface, do not reflect the effects of interaction with ground waters;

(b) vein, and to lesser extent, wall rock, $\delta^{18}O$ values decrease progressively (smoothly) downhole; and

(c) wall rock values are slightly higher than vein samples (0.5-1 per mil), but there is no systematic variation in the difference with depth.

INTERPRETATION

The decrease in $\delta^{18}O$ values with depth is consistent with (but by itself doesn't prove) the existance of a $\delta^{18}O$-depletion halo (as described by Waring, 1990).

The relatively small and consistent difference in vein and wall rock dolomite $\delta^{18}O$ values indicates vein-wall rock isotopic equilibrium. The vein-forming fluid apparently became progressively `heavier' up-hole *but* was sufficiently `pervasive' to control the isotopic chemistry of the surrounding wall rock carbonate.

DISCUSSION

The small 3 per mil (11-14‰) range in vein $\delta^{18}O$ values between the surface and 780m downhole is entirely consistent with DDH V334 being situated well within the proposed Isa Cu depletion halo. Of particular interest to us is not so much the magnitude of the end-member values that define the 3 per mil range, but the persistence of vein-wall rock equilibrium almost 800m vertically above known copper mineralisation. That is, a range of 15 to 18 per mil in wall rock values would be just as interesting if vein values followed suit.

One question which arises from this observation is the shape of the `equilibrium' halo or its geometric relationship to silica-dolomite at depth. For the vertical DDH V334, isotope contours can be drawn, in E-W cross section, either sub-parallel to bedding, as currently accepted, or subhorizontal to the surface. Sub-horizontal contours are a possibility at 3600mN given the lack of an isotopic gradient, from east to westfor hundreds of metres, just above the Greenstone Basement at 3600mN (Fig.2).

In both cases the isotope contour interval should be related to the size of the hydrothermal system (other factors such as host rock type and permeability being equal). Thus, a distance of 300m between the 11 and 14 per mil contours probably indicates a larger system than say 100m. This line of reasoning can be used to assess other mineralised areas such as Crystallena, Hilton, Native Bee and N.W. Lakes.

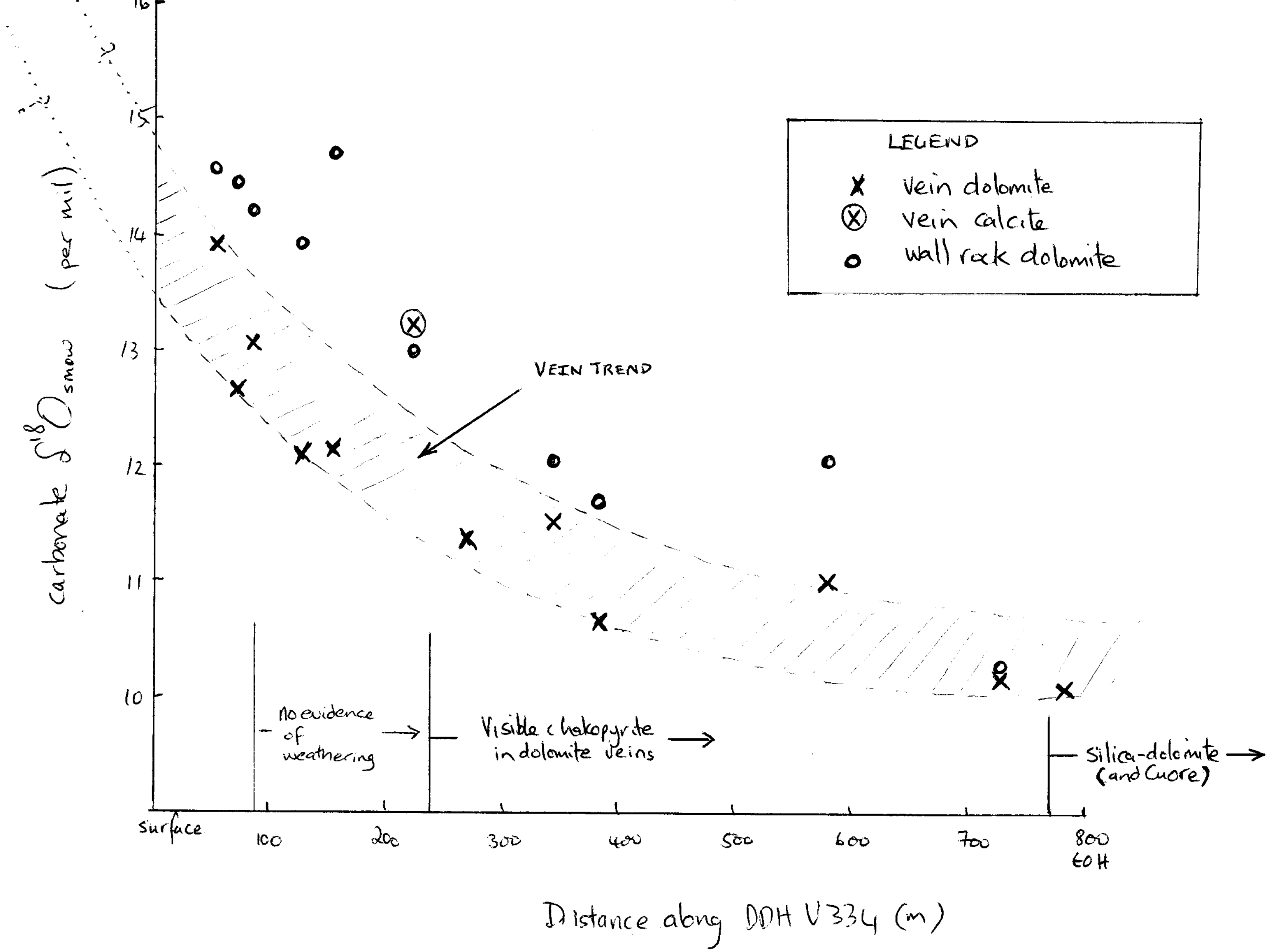
A quick review of the available isotope data (interim reports and computer files of C. Waring) reveals that most analyses are for bulked whole rock samples (*i.e.*, wall rock with or without veins), and that in several cases the *gradient* in $\delta^{18}O$ values is much the same as that along DDH V334 (see Figs. 3-5). How would we interpret this kind of data in a new area, particularly if we were constrained by a 200-300m diamond drill hole cut-off?

Although the above problem is one which Chris Waring is tackling at present, the question should also be asked whether the vein-wall rock isotopic equilibrium evident in the V334 data is actually present in other studied areas. The question could quickly be addressed by returning to selected holes and analysing *vein material* from portions of previously bulk-analysed core. It is possible that both vein- and wall rock-carbonate analysis will enhance the applicability of stable isotope-based assessment at a relatively early stage of scout drilling programmes.

Suggested drill holes for vein sampling and analysis are:

> DDH T363 ED1 at Isa Mine (see Fig.2) to complement and hopefully verify the V334 data and imminent data from DDH A360 (Waring, in prep.);
>
> DDH Q125 and/or Q250 between Crystallena and the 1100 orebody (see Fig.3) to test a peripheral part of the Mount Isa system.
>
> DDH F320 ED1 at south Hilton (see Fig.4), note the comprehensive isotope depletion at this location; and
>
> DDH EH678 (NWLakes 5), note the steep isotopic gradient at this location (Fig.5), suggesting an originally `small' hydrothermal system.

FIGURE 1 Summary of Carbonate $\delta^{18}O$ data from DDH V334



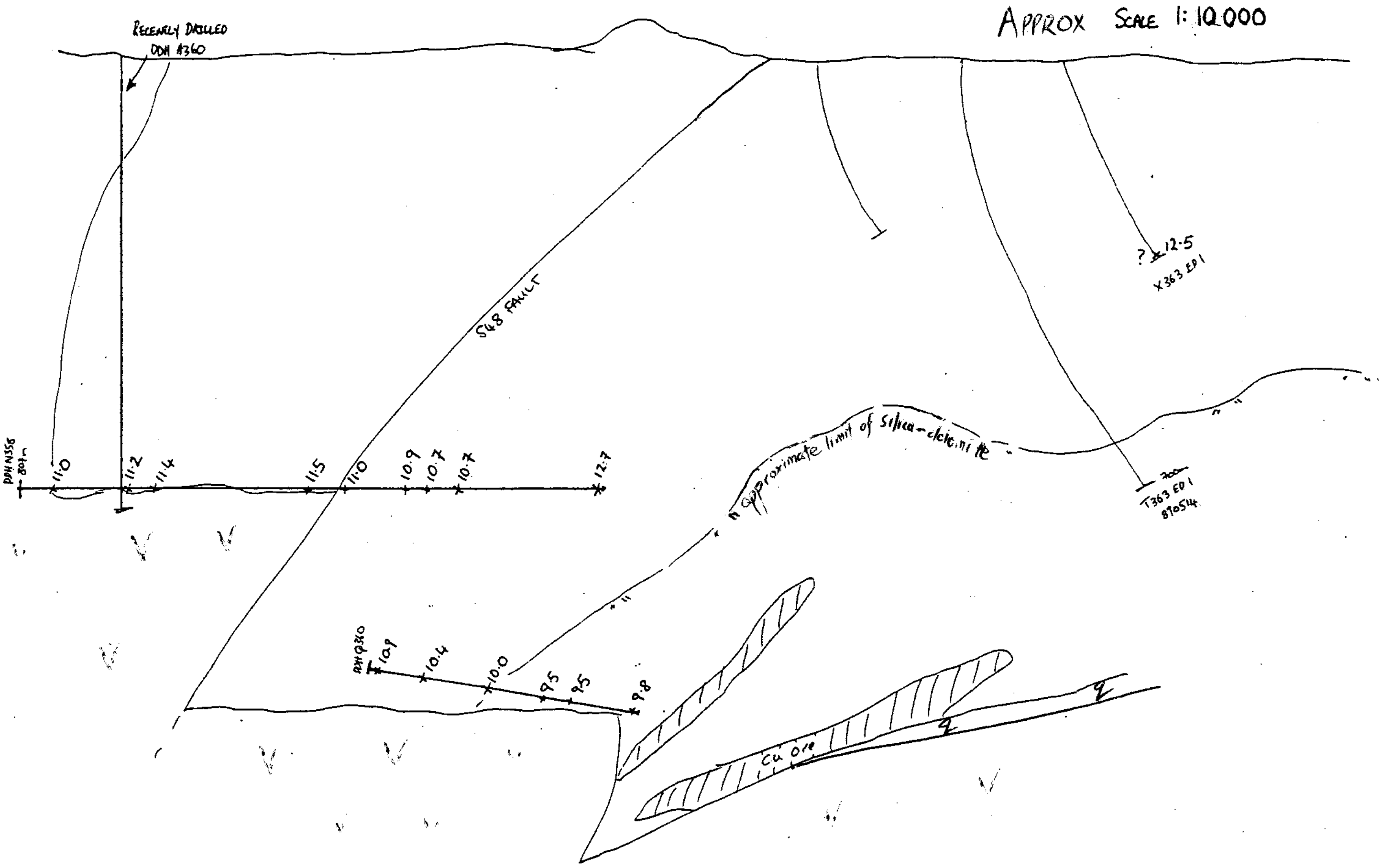


FIGURE 2 Dolomite $\delta^{18}O$ values from drillholes at 3600m N
(drill hole traces approximate)

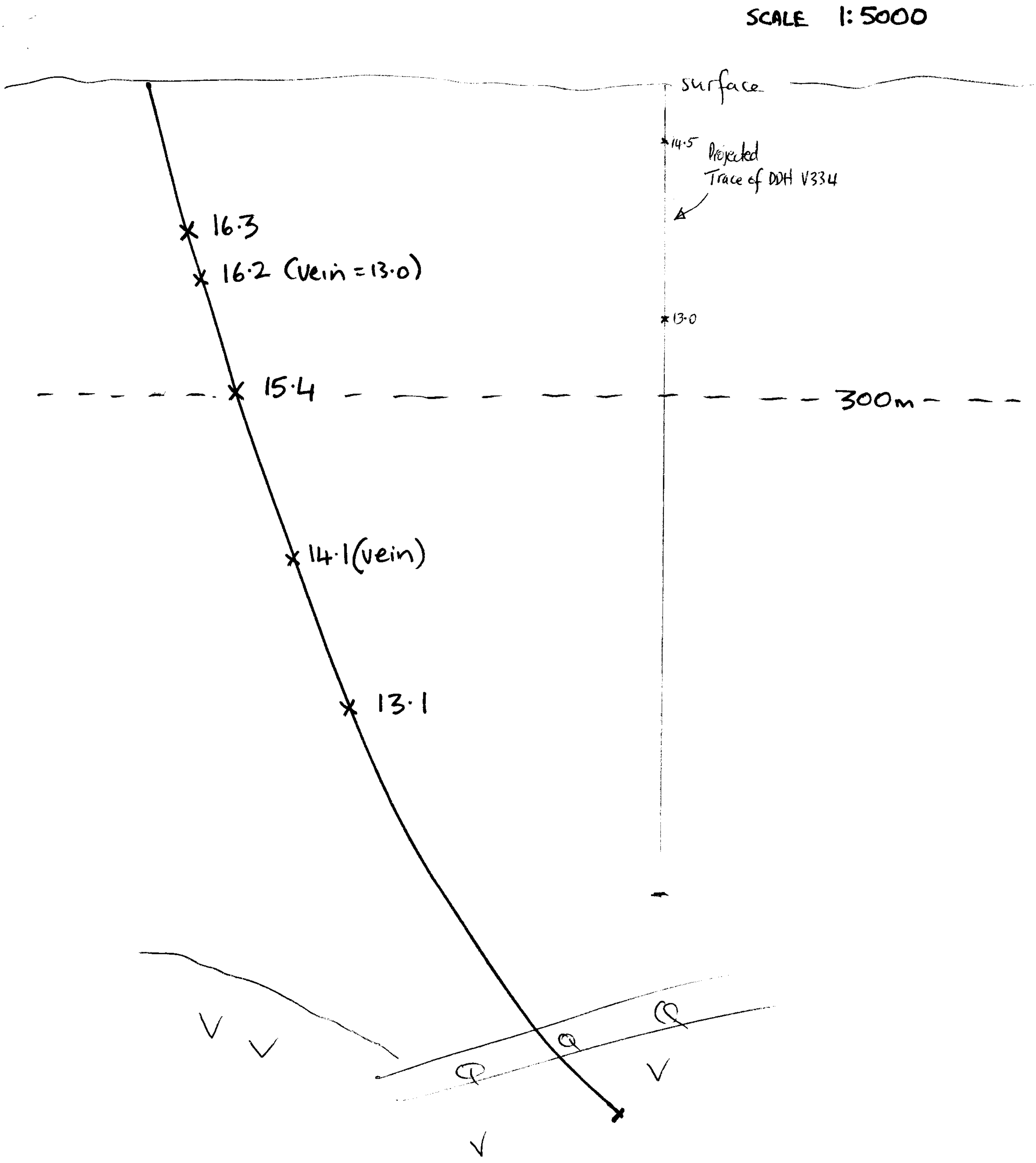


FIGURE 3 Dolomite $\delta^{18}O$ values along DDH Φ125 and Φ250 (schematic compilation)

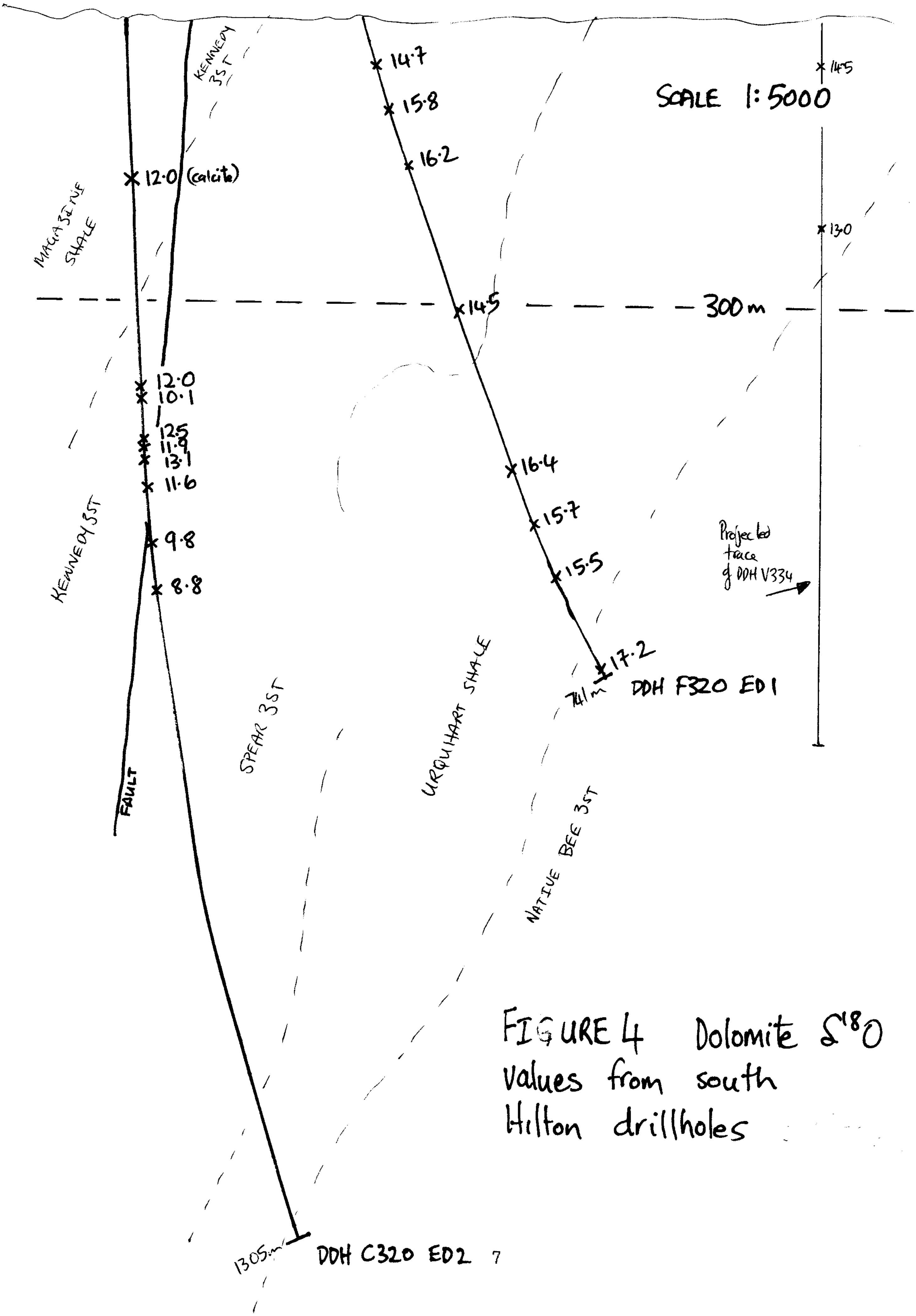


FIGURE 4 Dolomite $\delta^{18}O$ values from south Hilton drillholes

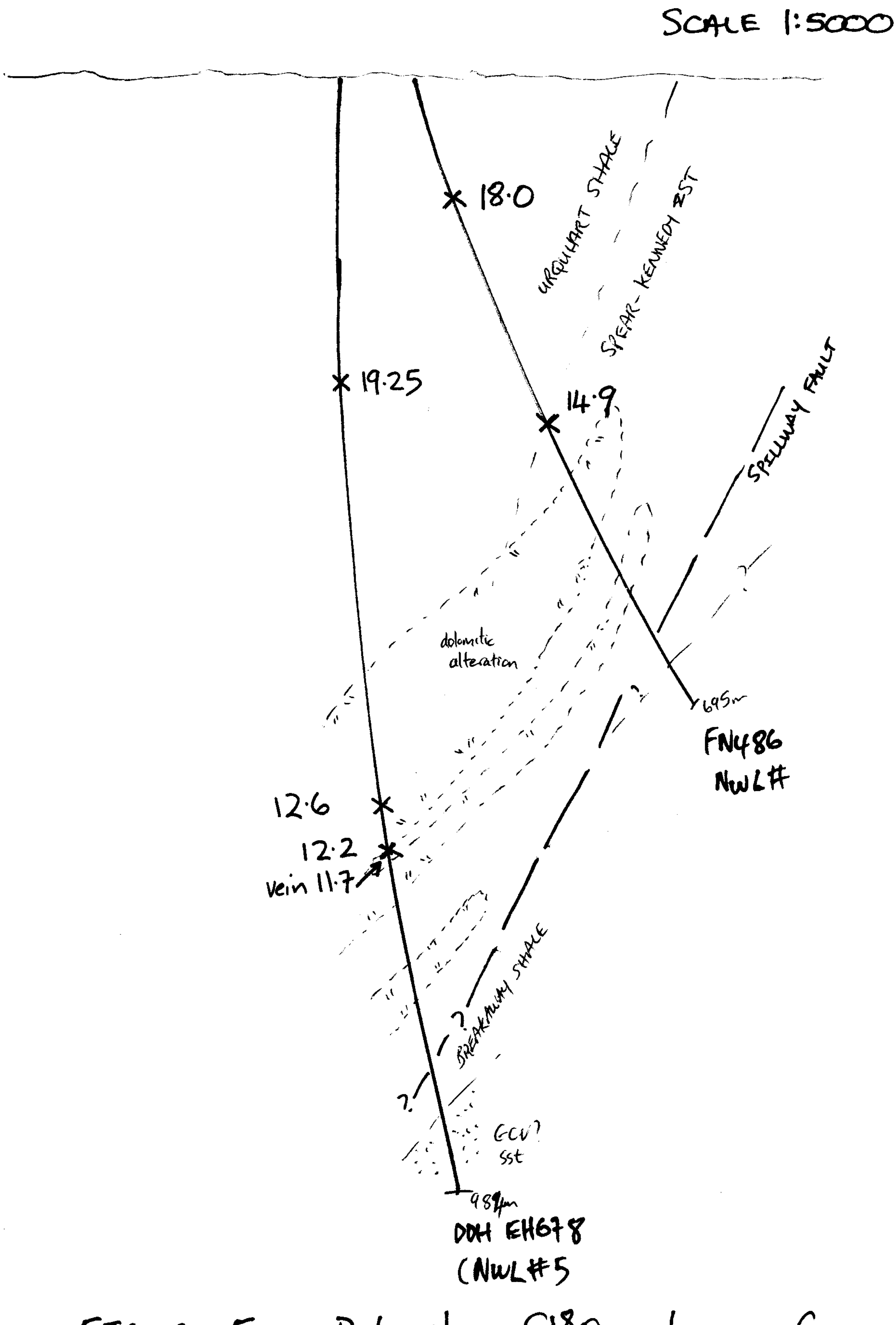


FIGURE 5 Dolomite $\delta^{18}O$ values from northwest 8 Lakes drillholes

REFERENCES

Hannan, K.W., 1991, A study of DDH V334 as part of the Halo Project: distribution of visible sulphide, vein orientations, and carbonate chemistry: Technical Report 1573, Carpentaria Exploration Company Pty. Ltd., 29pp. plus diagrams, tables and appendices.

Waring, C.L., 1990, Genesis of the Mount Isa Cu Ore system: unpublished Ph.D. Thesis, Monash University.

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