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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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A GEOCHEMICAL ORIENTATION STUDY IN THE GEORGETOWN INLIER, NORTH QUEENSLAND - PRELIMINARY RESULTS

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ABSTRACT

In 1972 the Bureau of Mineral Resources carried out stream sediment orientation studies in the Precambrian Georgetown Inlier of north Queensland, preparatory to starting a regional geochemical survey. Preliminary results indicate that for the Georgetown Inlier the -100 BSS mesh fraction is the smallest size fraction readily available in all streams; that for some elements geochemical contrast increases markedly with decreasing particle size; and that dispersion trains are short. The studies have been continued and expanded in 1973 to include soils and heavy mineral concentrates.

Introduction

In 1972 the Bureau of Mineral Resources began a program of regional geochemistry as part of detailed geological and geophysical investigations of metalliferous provinces in northern Australia.

The regional geochemistry (of rock, soil, stream sediment and heavy mineral concentrates) is to be used to aid the assessment of the mineral resources of these geological provinces, to delineate favourable areas for mineral search, and to develop geochemical exploration methods most suited to the geological and weathering environment of the respective provinces. The immediate objectives of the geochemical work are: to map the regional distribution of minor and trace elements, and to investigate the dispersion of minor and trace elements during weathering and erosion of selected rock units and mineralized zones.

Preparatory to starting the regional geochemical surveys, a joint Bureau of Mineral Resources/Geological Survey of Queensland party in 1972 undertook geochemical orientation studies in the Georgetown Inlier. The objectives of these studies were as defined by Plant (1971) i.e. to identify problems specific to the area to be mapped; to design a system to enable error to be controlled adequately at the sampling and analysis stages, and to determine whether or not the regional variance is significantly greater than the procedural errors.

Georgetown Inlier

The Georgetown Inlier is a 26000-km^2 area of Precambrian metamorphic and igneous rocks and Palaeozoic volcanic cauldrons and related intrusives in the Cairns-Townsville hinterland, north Queensland (Fig. 1). Metalliferous mineralization occurs mainly as small discrete veins; small gold, silver-lead, and copper deposits were the most commonly exploited.

The region is semi-arid with an annual rainfall of about 630 mm, almost all of which falls in December to February. For the remainder of the year all the streams are dry, or consist of a chain of widely separated semi-permanent waterholes. There are a few small spring-fed streams that run for most or all of the year, but sediment transport during the dry period is negligible. Most of the bedrock is dominantly felsic and the area was once covered by quartzose Mesozoic sediments, remnants of which abound. Thus stream sediment consists mainly of quartz and feldspar and geochemical relief and background values are low.

Orientation study

The orientation stream sediment studies were based on samples collected from areas selected to represent the main lithological units of the Georgetown 1:250 000 Sheet area (Fig. 1). These comprise Precambrian metasediments, amphibolite, granite, and pegmatite, Palaeozoic felsic volcanics and related granite, and Mesozoic quartzose sediments. Several mines, gossans, and mineralized areas were studied for comparison with the unmineralized areas.

Sediment is abundant in all drainage channels except the smallest gullies, but as most of it consists of coarse sand and gravel, large amounts have to be sieved to extract the required 25 g of fine material.

One or two study areas for each lithological unit (Type A, Fig. 1) and for each type of mineralized zone (Type B, Fig. 1) were selected within the area of Fig. 1. Each study area consisted of a 10-15 km^2 drainage basin from which about 20 samples were collected in duplicate. The samples consisted of about 20-50 g of dry sieved -85 mesh BSS stream sediment. One bulk sample from each study area, usually collected at the exit of the drainage basin, consisted of about 10 kg of unsieved sediment. Only recently deposited (active) sediment was collected, and bank or bank-contaminated material was avoided except when collected specifically for comparison purposes. Details of the sample location, site significance, etc. were recorded at each sample site. In some study areas, streams draining mineralized areas were sampled at small, but increasing (300-1000m), intervals downstream from the surface mineralization to study the length of dispersion trains. Two hundred sites (most representing 10-15 km^2 drainage basins) in the surrounding areas were also sampled to obtain regional background values.

Selection of size fraction

A major aim of the orientation survey was to determine which size fraction was readily available in adequate amounts (e.g. more than 25g from 5kg of sample), and would also give the best geochemical contrast.

The fourteen 5–10kg samples of unsieved stream sediment were sized using 18, 44, 60, 85, 100, 150 and 200 BSS size meshes, and it was found that the -100 mesh material is the finest size fraction available in adequate amounts in all of the study areas.

Geochemical contrast as a function of particle size

Each of the size fractions (-18 to +44), (-44 to +60), (-60 to +85), (-85 to +100), (-100 to +150), (-150 to +200), and -200 (BSS) in each of the 14 samples were analysed for: Be, Li, Cu, Pb, Zn, Ni, Fe, Cd, Mn, Cr, Co and Mo by atomic absorption spectrophotometry; V, W, Mo, Rb, Ta, Nb, Li, P, Tl, Sn, Bi, Ag, Ga, Ge, Sb, Ba, Sr, Y, La, Ti and Sc by emission spectrometry; U, Th, As by X-ray fluorescence. The elements Be, Cr, Mo, Co, W, Ta, Nb, Tl, Sn, Bi, Ag, Ge, Sb, La, Sc, and As were in concentrations at or below detection limits for most samples and were of no use in the study of geochemical contrast.

The geochemical contrast as a function of particle size was calculated and plotted as described by Plant (1971). Some elements, e.g. Ni, gave consistent data which indicate that geochemical contrast increases as particle size decreases (Fig. 2). However most elements gave irregular curves, e.g. Rb (Fig. 3).

Determination of sampling and analytical error

Garrett's (1969) method of computing the sampling and analytical variance based on replicate sampling and analysis was used to determine the quality of the data. Garrett states that as a rule of thumb the variance ratio F (where F = data variance/sampling & analytical variance) should exceed 4.0 for sampling and analytical errors to be significantly small at the 95 percent level. For many of the elements enalysed the analytical error appears to be excessive. Further studies are under way to improve analytical precision and to assess and reduce sampling errors.

Presentation of data

The frequency, and cumulative frequency distribution of about 500 samples were plotted for the elements Cu, Pb, Zn, Ni, V, Ag and Sn on both normal and logarithm scales. The data are clearly log normally distributed.

Class intervals based on the geometric mean and the geometric standard deviation as defined by Plant (1971) were used to classify the data as low background, background, high background, threshold, or anomalous. The data from all sample sites were contoured accordingly.

Dispersion trains from small areas of anomalous Cu, Pb, Zn, and Ni were commonly found to persist no more than 1 to 2 km downstream, regardless of the initial concentrations of the metals.

Continuing studies

It has been found necessary to extend the base of the orientation studies with sampling and analysis of soils and heavy mineral concentrates, further stream sediment studies (including evaluation of sample site variance), and the design and testing of a method of rapid stream-sediment sample collection using a helicopter. The field work for these studies is now complete and analyses and evaluation studies are continuing.

References

GARRETT, R.G., 1969 - The determination of sampling and analytical errors in exploration geochemistry. Econ. Geol., 64, 568-74.

PLANT, J., 1971 - Orientation studies on stream sediment sampling for a regional geochemical survey in northern Scotland. Trans. Instn. Min. Metall. (Section B: Appl. earth Sci.), 80, B324-44.

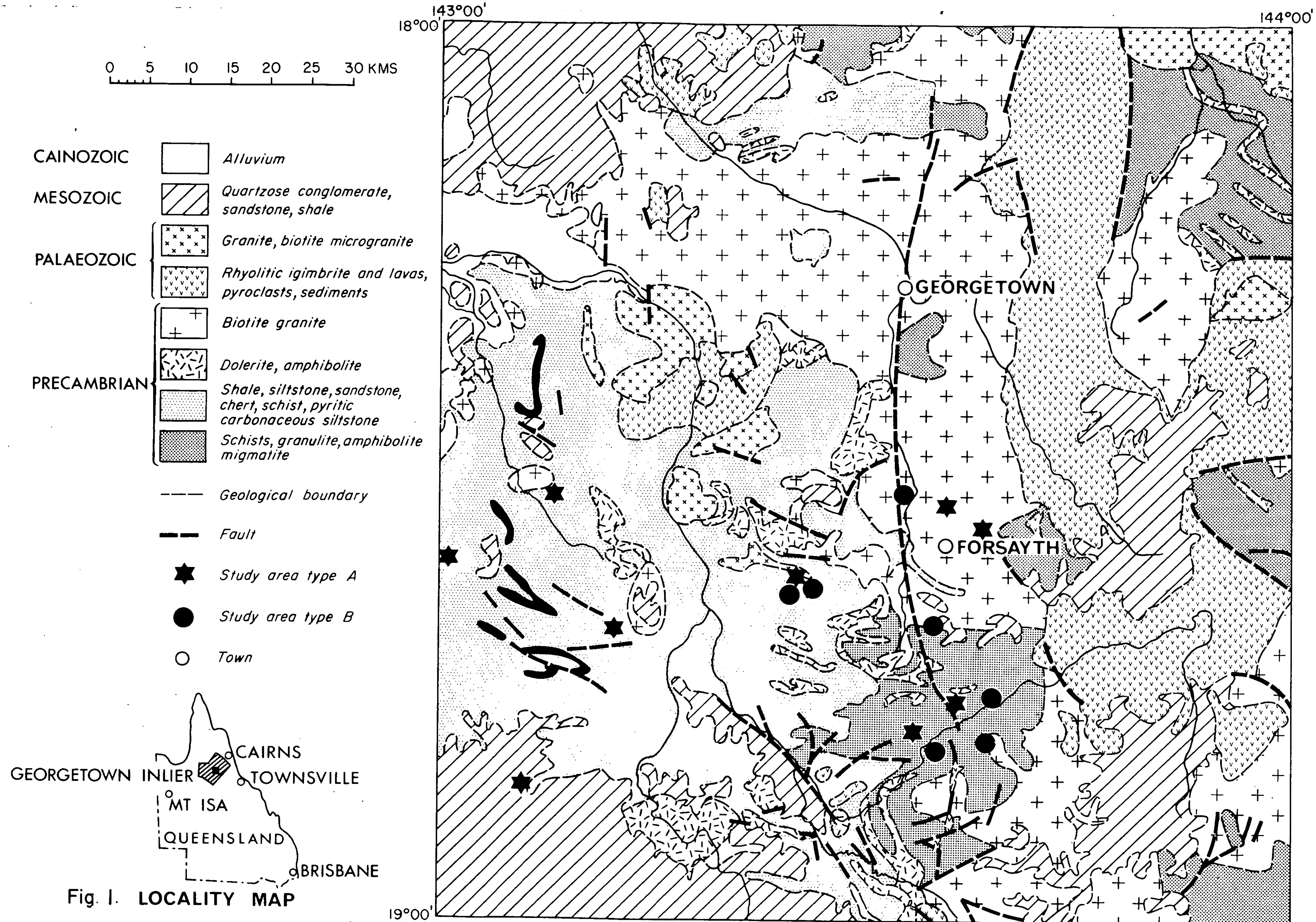

Fig. 1. **LOCALITY MAP**

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Fig. 2

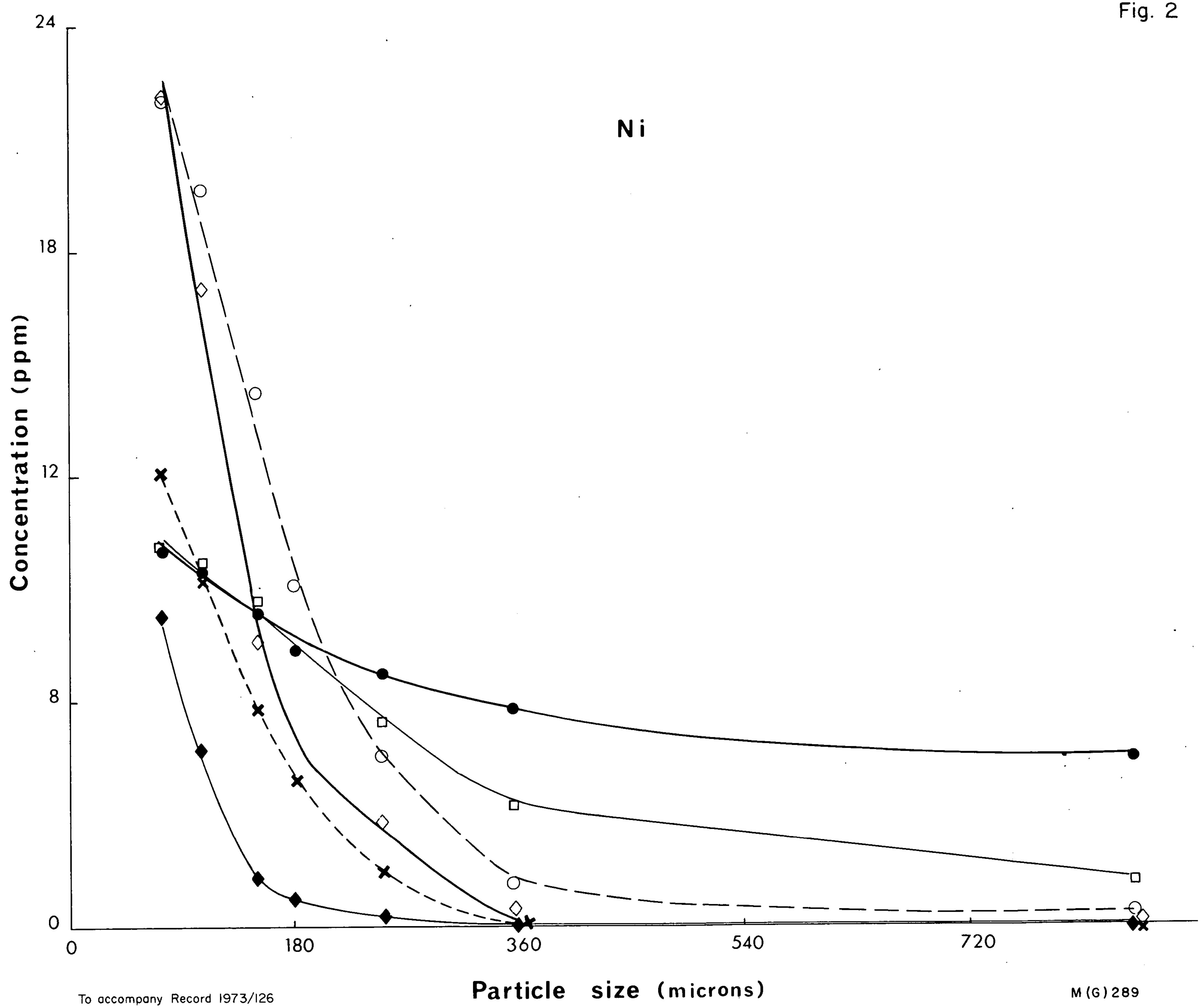

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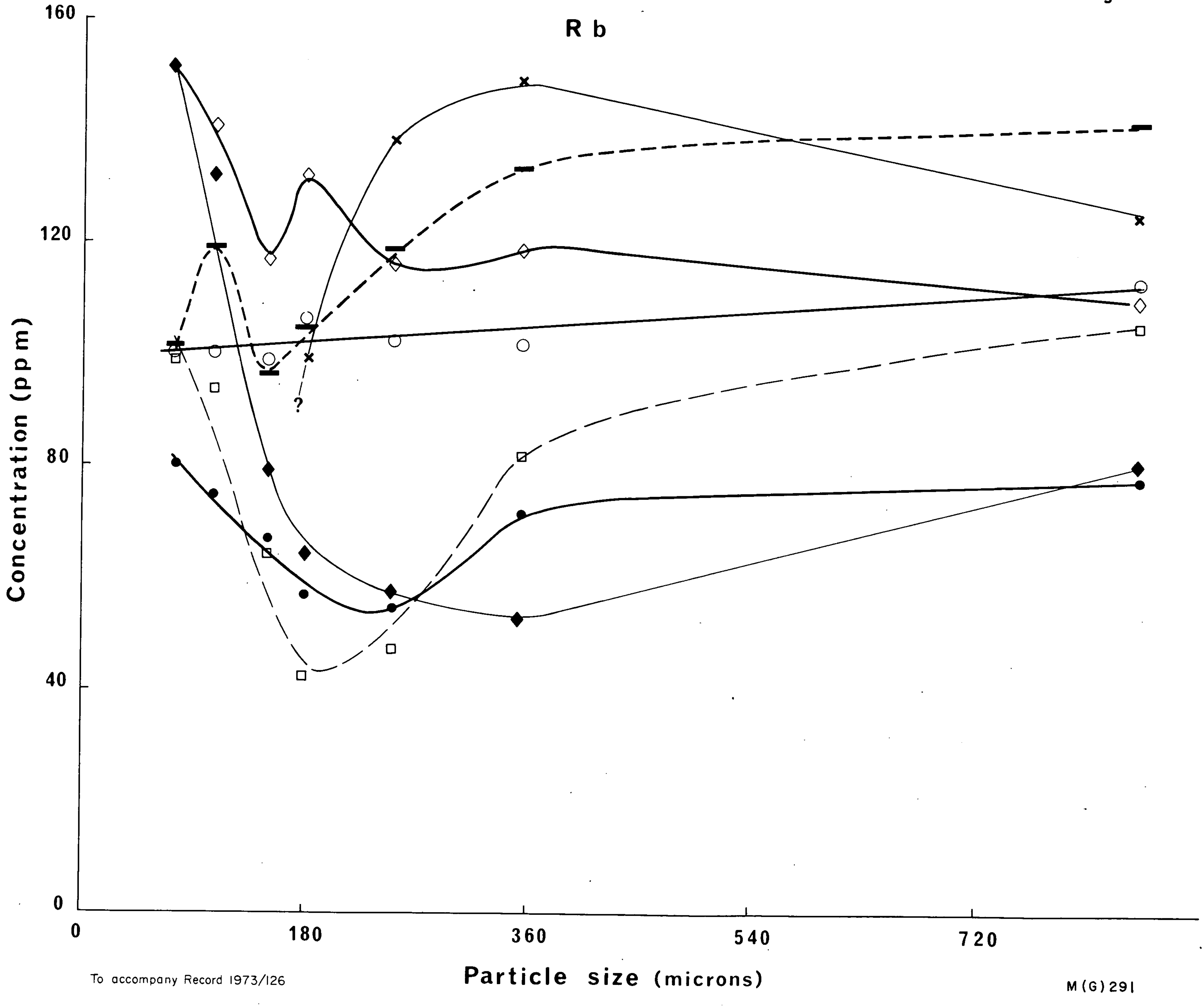
Fig. 3



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