SHORTER COMMUNICATIONS

MODEL LEAD AGES OF SOME GALENAS FROM KARNATAKA

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Galena ages are important as the age relationships between sulphide mineralization events and the emplacement episodes in the host rocks are quite complex, more so in the Precambrian terrain of Karnataka where even the limited available geochronological data have disclosed several emplacement and metamorphic episodes.

The calculation of a galena age depends on the mathematical model that specifies the isotopic constitution of the lead as a function of geological age—this being represented by the 'growth curve' of $y=(Pb^{207}/Pb^{204})$ vs $x=(Pb^{206}/Pb^{204})$. In the case of *'conformable leads'*, the data points for these isotope ratios cluster close to the growth curve that passes through the points for primieval lead ($b_o=10.42$, $a_o=9.46$, $t=4550$ m.y.), and the data point on the growth curve corresponds to the crystallization of the ore body from a source (mantle) of uniform U/Pb and Th/Pb ratios. *'Anomalous' leads* that have exchanged radiogenic lead with country rocks yield points outside the conformable growth curve, but even in such cases, one can arrive at values for the ages of ore emplacement, and of the rock bodies that contribute radiogenic lead component, by extrapolations to the growth curve (Russell, 1960).

In the present study an attempt has been made to determine the isotopic ages of galena from three localities in the Precambrian of Karnataka – Ingaldhal (14°11' : 76°27') Chitradurga district, Arothikoppal (76°49'20" : 12°22'15") Mysore district and Metri (76°37' : 15°18') Bellary district. The data so gathered are evaluated in determining episodes of mineralization.

Geological setting: Samples of Galena from Ingaldhal were collected from the copper bearing lodes traversing the altered pillow lavas of that region. The host rock in its present condition is an epidiorite. Other ore minerals associated are chalcopyrite, pyrite and a little amount of sphalerite. A Rb-Sr isochron age of the Pillow lavas has been determined to be 2,380 million years (Crawford, 1969).

Galena from Arothikoppal is from quartz veins traversing the gneissic rocks. No other sulphide minerals are seen, except minor amounts of chalcopyrite and pyrite associated with galena. There are a number of felsite dykes in the neighbourhood and the sulphide mineralization may probably be connected with the igneous activity which gave rise to these felsites.

Metri is in Hospet taluk of Bellary district. Chunks of galena are noticed at the surface imbedded in a mass of kankar. The galena has been traced to a pegmatite striking NNW-SSE. An examination of the area in the neighbourhood of Metri indicated galena mineralisation confined to a felsite dyke near Devalapuram. Mineralization in this region and in the case of Arothikoppal appears to be associated with the igneous activity giving rise to felsite and pegmatite veins.

Experimental results: Specimens of galena were hand-picked pure crystals. These were washed with HCl and ground with pure alcohol and coated on the side

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filaments of the triple-filament thermal ionization source. The AEI-MS 702 mass spectrometer was used for the analysis of isotope ratios. The ion current output was amplified by an electron multiplier (used with a low gain for good stability) and sets of 40-50 spectra recorded for each measurement. Correction factors for isotopic discrimination by the multiplier were made by replicate analysis of SRM 981 to provide normalisation of data.

The results are given in Table I which shows the isotope ratios Pb^{206}/Pb^{204}, Pb^{207}/Pb^{204}, and Pb^{208}/Pb^{204} with standard deviation errors. These are plotted on the conformable lead growth curve in Fig. 1.

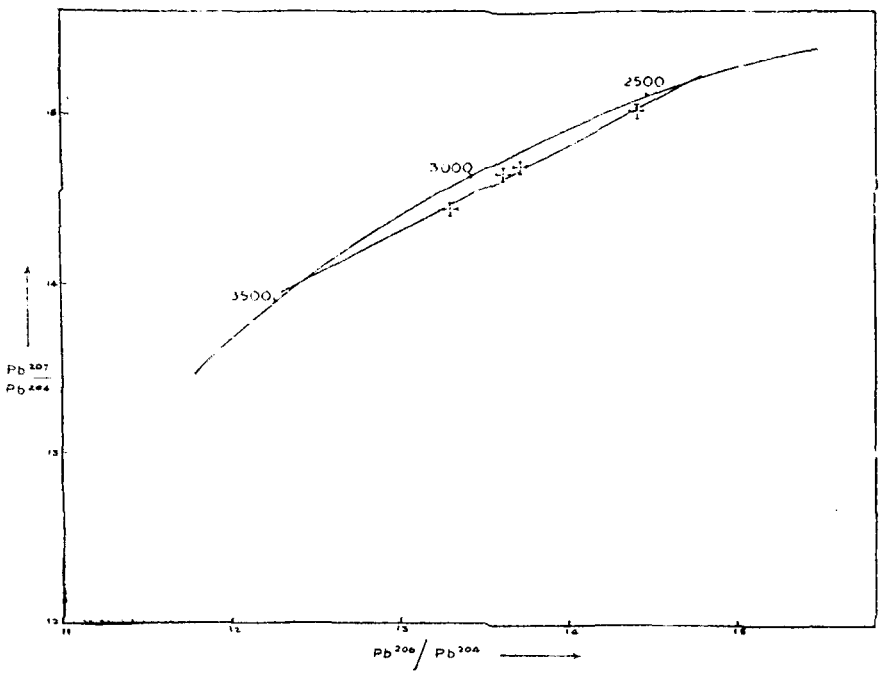

Figure 1. Lead isotope ratios for galenas, Ingaldhal.

TABLE I

Locality	*Sample*	$\frac{Pb^{206}}{Pb^{204}}$	$\frac{Pb^{207}}{Pb^{204}}$	$\frac{Pb^{208}}{Pb^{204}}$
Ingaldhal	I	13.28 ± 0.04	14.44 ± 0.04	33.05 ± 0.1
	II	13.60 ,,	14.64 ,,	33.68 ,,
	III	13.70 ,,	14.70 ,,	33.80 ,,
	IV	14.40 ,,	15.02 ,,	34.60 ,,
Arothikoppal	I	16.30 ,,	15.51 ,,	35.80 ,,
	II	16.33 ,,	15.50 ,,	36.20 ,,
Metri	I	16.82 ,,	15.65 ,,	36.50 ,,

Discussion: The plots of the data from Ingaldhal do not fall on or outside the growth curve. They however show a good linear fit of (Pb^{206}/Pb^{204}) vs (Pb^{207}/Pb^{204}). This can be explained by a model which assumes simple mixing of two sources with different isotopic compositions, corresponding to ages given by the intersections of the plot with the growth curve – viz (2400 – 2500) m.y. and (3400 – 3500) m.y. (Fig. 1).

Similar results have been obtained by Russell and Farquhar (1960) and Kanasewich (1965) for the galenas of the Cobalt-Noranda area, Canada, where the earlier age (3250 m.y.) has been interpreted as a first period of mineralization that concentrated the sulfides in long faults that follow the regional strike, while these faults provided the channels for the later (2300 m.y.) mineralization event.

The later mineralization age corresponds closely with the Rb-Sr isochron ages for the granites of Chitradurga (2475 ± 80 m.y.), (Venkatasubramanian, 1974a) as well as the Rb-Sr ages of pillow lavas (2380 m.y.). The earlier age value is interesting and supports the idea of a basement for the Dharwars, relicts of which, occur as conglomerates viz. Some of the granite pebbles in Kaldurga, have given the highest ages recorded so far at 3250 ± 150 m.y. (Venkatasubramanian, 1974b). An earlier Houterman's curve 'model' age of 2450 ± 120 m.y. has also been reported (Aswathanarayana, 1956) for Chitradurga galenas.

The data on the Pb^{208}/Pb^{204} ratios yield a linear plot of slope R, corresponding to (Th/U) = 5 as calculated from the expression (Russell and Farquhar, 1960),

$$R = (Th/U)\ (\lambda''/\lambda)\ e^{-(\lambda - \lambda'')t}, \text{ for } t = 2500 \text{ m.y.}$$

The quartz reef samples (Arothikoppal) yield conformable data reflecting a single stage history of emplacement at 1400 – 1560 m.y. The samples of (Metri) yield again similar conformable data corresponding to 1220 – 1320 m.y. It is known (Crawford, 1969) on the basis of limited Rb-Sr age data that the felsite and feldspar dykes are of younger post-Archaen age and the galena ages probably reflect these later episodes.

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