

should be critically analysed in terms of likely diffusion models and tests should be made of the homogeneity and equilibration of isotopes and refractory trace elements among different mineral phases. Recently published data<sup>5</sup> show a correlation of pyroxene-garnet Mn/Mg and V/Al ratios with clinopyroxene-orthopyroxene temperatures suggesting equilibration of these trace elements. However, the same authors note grain-by-grain relative inhomogeneities of 25% in Cr and Sc contents of the garnets and similar results have been observed elsewhere<sup>6</sup>. Similarly our work has shown that pyroxene-garnet Cr/Al distribution coefficients are widely scattered for the low temperature group of granular nodules but are more tightly grouped in the case of sheared nodules. Isotopic disequilibrium in garnet and spinel ilherzolite nodules has also been reported<sup>7-10</sup> although it seems that in the case of garnet ilherzolites this applies only to sheared nodules, the granular nodules being apparently equilibrated and giving ages close to that of the host kimberlite<sup>7</sup>, despite their dominantly lower temperatures.

There are thus several contradictory pieces of evidence concerning equilibrium in garnet ilherzolite and xenoliths and hence uncertainty in their use for the calculation of geothermal gradients. When alternative geobarometers and more isotopic, trace element and kinetic data become available these issues should be more easily resolved.

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## Paternal behaviour in fishes: a question of investment, timing or rate?

DAWKINS AND CARLISLE<sup>1</sup> have shown that Trivers' parental investment model<sup>2</sup> of tetrapod maternal care rests on a fallacy, and suggest that maternal behaviour in tetrapods and paternal behaviour in teleost fishes is a result of the relative timing of gamete release. Like Dawkins<sup>3</sup>, I view evolution as the selective transfer of information from generation to

generation. However, I believe the fundamental difference between the sexes that leads to exclusive maternal or paternal care is the relative rate at which the two sexes can create gametic copies (spermatogenesis requires less time than oögenesis).

In externally fertilising species, optimal sites for zygote development may constitute a limiting resource for spawning individuals, which selects for site constancy and territorial behaviour. Males are favoured as site-constant individuals because in fishes (as in most vertebrates) males are able to produce new batches of fertile gametes and remate at shorter intervals than females<sup>4-8</sup>. A male monopolising a site will leave more descendants than a female occupying that site for the same duration. The male can remate, so roving females still spawn at their maximum rate, and their sons will show the site-constant trait. A territorial male's success is limited by the number of females he can attract; hence the sexual adornment in parental male fishes<sup>9-11</sup>. Parental behaviour evolves as a consequence of acts by the male that promote survival of the zygotes at his site. Where reproduction is not tied to a site, the female will be favoured as the parent because her potential gain from multiple mating is the lesser.

The relative rate of production of gametes is central to the question of sexual selection and follows directly from Dawkins' property of 'fecundity'<sup>3</sup>. Questions of efficiency and energy are not important, except in that they influence the rate of reproduction. The model can be used to explain the evolution of anisogamy, substituting rate for the numerical productivity used by Parker, Baker and Smith<sup>12</sup>. The present model views the evolution of solitary male or female parental care as a cooperative outcome that allows individuals of each sex to maximise their production of offspring.

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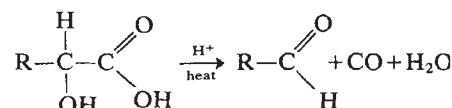
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## Acid hydrolysis and $\alpha$ -hydroxy acids in meteorites

THE study by Peltzer and Bada<sup>1</sup> of  $\alpha$ -hydroxycarboxylic acids in the Murchison meteorite is of considerable interest because it not only presents a different class of molecules to be looked for in meteorite studies, but also provides a possible method for an evaluation of the ammonia content of the environment in which the synthesis of the organic compounds took place. However, I feel that their analyses of the results leave a room to be filled.

They found less  $\alpha$ -hydroxy acids in the acid-hydrolysed water extract fraction than in the unhydrolysed fraction. It is known that  $\alpha$ -hydroxy acids decompose to aldehyde and CO when boiled in dilute sulphuric acid, with an overall reaction



As this reaction is known to proceed quite readily, I suspect that this could be the main cause of their observation. Peltzer agreed on this point in his personal communication, saying "the acid-catalysed decomposition of  $\alpha$ -hydroxy carboxylic acids probably accounts for the decreased recoveries of the compounds following acid hydrolysis". This in turn would question their conclusion that the hydroxy acids in the meteorite exist primarily in a free or water-hydrolysable state, as their procedure allows whatever  $\alpha$ -hydroxy acids are produced through the acid hydrolysis to decompose at the same time to aldehydes. Their conclusion still seems valid, however: Peltzer, in the same personal communication, states that the recoveries of standard compounds at levels equivalent to those found in the meteorite were measured, and that acid hydrolysis recoveries for most hydroxy acids were approximately 10-20% lower than those by water hydrolysis; this extent of the decomposition does not seem large enough to reverse their conclusion.

As the majority of amino acids in meteorites exists in some kind of precursor form and is released only on hydrolysis in 6 M HCl (ref. 2), it would certainly be interesting to study the possible causes for the different states of existence of  $\alpha$ -hydroxy acids and of amino acids.

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