and Allègre have done, is $(0.96)^{32}$, that is, 0.27. Although 27% is not a very high probability, it is nevertheless far too high to be disregarded. Schärer and Allègre have not analysed a sufficiently large number of zircons to decide whether there are any old grains in the original Froude *et al.* concentrate or not. All that can be concluded from their results alone is that the abundance of old grains is less than about 9%, which would give a probability of successively selecting 32 young grains of <0.05. If we now accept that Froude *et al.*'s abundance estimate of 0.04 for the old grains has an uncertainty of the order of 0.02, it becomes obvious that many more grains than 32 must be analysed before the existence of the old grains could be excluded with any confidence. Schärer and Allègre admit that grain selection as the reason for their lack of old grains 'cannot be completely eliminated', but that single sentence is not an adequate assessment of the statistical issue.

We regret that Schärer and Allègre were apparently misled by Fig. 3 of Froude *et al.* into believing that all four old zircons had the same appearance as Froude *et al.*'s grain 34. Grain 34 alone is unique: morphologically, the other old grains cannot be distinguished from the rest of the population. For this reason, Froude *et al.* analysed at random all except the very turbid zircons rather than a prior selection according to this or that visual criterion. Schärer and Allegre did make a prior non-random selection. It seems possible, therefore, that they may have unwittingly biased their grain selection against the old zircons.

Our current estimate for the abundance of old zircons in the same concentrate used by Schärer and Allègre is 5 in 260. Each of the original four old grains has been reanalysed by ion probe (with good agreement), and one more has been discovered in a total of 158 new zircons analysed. At this lower observed abundance, the chance of missing an old grain in 32 successive selections is slightly more than 50%. On this basis, it is no surprise that Schärer and Allègre did not find one.

Schärer and Allègre perceive differences in discordancy patterns between their data and those of Froude *et al.* We do not agree that there are any significant differences between the two set of analyses, as long as the greater experimental uncertainty in measuring Pb/U by ion probe is taken into account. In fact, we consider that Schärer and Allègre have confirmed Froude *et al.*'s results for the 3,750 Myr-old and younger zircons. The data for all 20 of Froude *et al.*'s young zircons fall along and extend the discordancy band shown in Schärer and Allègre's Fig. 2*a* between 3,750 Myr and 1,400 Myr. Those that fall above Concordia mainly represent valid excursions along a correlated y-x error locus due to uncertainty in determining Pb/U, which is greater for the ion probe (see Table 1 of Froude *et al.*[22]) than for isotope dilution analyses to which conventional zircon geochronologists are accustomed. A few analyses above Concordia for the old zircons belong there because of local metamorphic redistribution of Pb, as documented recently by Williams *et al.*[4]. It is true that such 'reverse discordance' is rarely if ever found in conventional work. This probably reflects the difference in sampling scale between ion probe analyses, which typically consume a few nanograms of zircon, and conventional analyses which at best consume a few micrograms[5] and typically many milligrams, thereby averaging out any fine-scale variation in Pb/U.

Schärer and Allègre also consider that the contrast between their consistently discordant ages for the young zircons and the "apparently concordant" ages of the old grains measured by Froude *et al.* presents a difficulty. The facts are that most of Froude *et al's* ion probe analyses of the old grains are slightly below Concordia, and two at most are above it. We concede that if Froude *et al.* had a systematic error of a few per cent too high in their measurements of Pb/U, the old grains would appear to be more condordant than they really are. However, Froude *et al.*'s results for the Isua zircons do not show a major effect of this sort. On the other hand, there is the following central question which Schärer and Allègre do not address: if the ion probe ages of >4,100 Myr are wrong, how can the high and very consistent values of $^{207}Pb/^{206}Pb$ for these particular samples be explained? The corrections for common Pb have negligible effects, the observed precision of the ratios is high and due mainly to counting statistics, there are no known isobaric interferences under ^{207}Pb, and the discimination between Pb isotopes during sputtering (in contrast to Pb^+ and U^+) is negligible. Why do Froude *et al.* measure the correct $^{207}Pb/^{206}Pb$ for the Isua zircons also?

Thus, we believe that Schärer and Allègre have simply been unlucky in failing to find any >4,100-Myr-old zircons, and that this is understandable when their low abundance is considered. There is no question of the reality of the old grains. Two more >4,100-Myr-old zircons have been found recently in a second quartzite horizon at Mt Narryer[6].

Finally, the preliminary interpretations of the young zircon data from the Mt Narryer quartzites given by Froude *et al.* and followed by Schärer and Allègre are now superceded by conclusions in new papers (refs 6, 7 and P. D. Kinny *et al.*, in preparation), which include discussion of the zircon age discordancy patterns, the timing of deposition and metamorphism of the quartzite, and the provenance of the (young) detrital zircons.

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SCHÄRER AND ALLÈGRE REPLY—The comment of our Australian colleagues is not surprising, but does not provide any new information, except one speculation which is incorrect. Zircon samples have not been selected according to any special criterion such as one which would eliminate old grains. Our 39 analyses, representing 32 grains, include zircons of all the different crystal types distinguishable in this sample. The probability calculations given above would rather reinforce our cautious but clear conclusions.

We are more interested in the truth than in promoting any peculiar technique. The only solution to the dilemma would be a re-examination of the >4,000-Myr-old zircons by isotope dilution, and an extensive study by both techniques on identical grains from populations with simple and well defined histories.

We thus take this opportunity to reiterate our offer to analyse any grain that they can send us, even just one, two or three. Furthermore, we would be grateful if the Isua ion probe data, to which the authors refer so frequently, could be published soon.

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