There are 11 sources detected in the UHURU and Ariel V surveys of this region which we have not seen. If these sources were at their catalogued intensities, then only one, 3U1901 + 03, should have been clearly above our detection threshold. Another one, 3U1912 + 07, would have been above our threshold if it were at the intensity reported in the 3U catalogue[2], but below our threshold at the intensity reported by Seward[3].

The current status, with regard to the identification of these objects, is as follows:

3U1822–00; there have been no proposed candidates for this source. There are no stars visible on the Palomar Sky Survey blue plate in the error circle and only a few on the red plate.

Ser X-1: Davidsen[8] proposed a candidate for Ser X-1 based on the SAS-3 quick-look results[9]. The object is a faint ($B \approx 18.5$) star with an ultraviolet excess. It is $\sim 4''$ from the centre of our refined error circle. Ser X-1 is also a source of X-ray bursts[10–12], the first burst source for which a stellar counterpart has been proposed.

A1845 – 02: There have been no proposed candidates for this source. The source lies in a heavily obscured region. There is only one star visible on the Palomar Sky Survey inside the error circle.

A1850 – 08: The globular cluster NGC6712 was proposed by Seward[3] *et al.* as a possible counterpart for A1850 – 08. Cominsky *et al.*[13], using UHURU data, and Grindlay *et al.*[14], using ANS data, improved the position determination of this source. In both cases, NGC6712 was consistent with the data, but field objects could not be ruled out. Our position for this source clearly identifies it with the cluster. The centre of the cluster is $\sim 30''$ from our best position, well inside the error circle. Of the known variable stars in the cluster, two long period variables, V2 and V8, lie within the error circle. Also lying within the error circle is V17, which was seen to vary by Harwood[15], but not by Sandage[16] or Rosino[17].

A1905 + 00: there are currently no proposed candidates for this object. The source has been identified as an X-ray burst source[11,18].

Aql X – 1: a candidate for Aql X-1 was proposed by Davidsen[19] based on the UHURU error box. This candidate is ruled out by our results.

3U1915 – 05: The star 26f Aql, suggested as a possible counterpart in the 3U catalogue[2] is not consistent with our results. This source was first proposed as a burst source candidate by Becker *et al.*[20] based on OSO-8 observations (error box area $\sim 13\ deg^2$) and has been confirmed with recent SAS-3 observations (error box area $\sim 0.1\ deg^2$ (ref. 24).

3U1956 + 11: Margon *et al.*[21] have proposed a candidate for this source based on the SAS-3 quick-look results[22]. It has a B magnitude of 19.0 with a spectrum similar to that of Sco X-1. It lies $10''$ from our present refined position.

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Supernovae, grains and the formation of the Solar System

James M. Lattimer

Department of Astronomy, University of Illinois, Urbana, Illinois 61801

David N. Schramm & Lawrence Grossman

The Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637

The observed ^{26}Mg and ^{16}O anomalies in meteorites can be consistently understood if a supernova occurred within a few million years of the condensation of the Solar System. Grains condensing in the ejecta from this supernova may be an integral aspect of this process.

THE detection[1,2] of excess ^{26}Mg which correlates with the Al/Mg ratio in a Ca-rich inclusion in the C3 chondrite Allende offers strong evidence that a nucleosynthetic event preceded the formation of the Solar System by at most a few million years. Two explanations for the production of ^{26}Al, which decayed to form the observed excess ^{26}Mg, have been presented. (1) An irradiation in the early Solar System[3] could synthesise the observed amount of ^{26}Al throughout a solar nebula of 1 $M_{\odot}$, but the energy required is greater than the binding energy of the Sun. This seems unreasonably large. In addition, excess amounts of other rare nuclides such as ^{40}K and ^{50}V, as well as neutron-induced isotopic anomolies in elements such as Gd, would be produced. No such anomalies have been observed to date. (2) One or more supernovae, which could produce ^{26}Al in either explosive carbon burning or in a high temperature carbon burning shell source immediately preceding the explosion, occurred near the protosolar cloud[4]. This supernova would have had to occur within a few ^{26}Al decay half lives (7.2×10^5 yr). The fact that the protosolar cloud condensed within such a short time of this supernova may not be accidental; the supernova trigger hypothesis of the formation of the Solar System has been considered by several authors (ref. 4 and S. Margolis, in preparation). We present here the results of our supernova grain condensation calculations and relate them to the hypothesis that a 'last event' supernova was indeed related to the formation of the Solar System and thus might have created the observed isotopic anomolies in magnesium, oxygen, neon and xenon.

Four components of presolar material are envisaged for the formation of the Solar System. The first two, interstellar gas and dust, have been enriched by supernova and nova debris (gas and possibly dust) and stellar winds, among other processes, throughout galactic history. The average composition of the dust may be chemically and isotopically different from the gas. The last two

Table 1 Isotopic anomalies and condensing minerals in supernova ejecta

Supernova zone	Non-solar isotopic abundance peculiarities	Major condensible species at 10^{-8} atm which also condense in the solar nebula*	
		C/O < 1	C/O > 1
(H)	$^{13}C(+)$, $^{15}N(\pm)$, $^{17}O(+)$	Al_2O_3	C, TiC, SiC, Fe_3C
(He)	$^{13}C(-)$, $^{15}N(\pm)$, $^{17}O(-)$ $^{18}O(\pm)$, Mg(n), Si(n) S(n), Ca(n), Ti(n), Fe(n)	$Ca_2(Al_2,MgSi)SiO_7$ $MgAl_2O_4$ $CaTiO_3$ $CaMgSi_2O_6$	AlN, CaS, Fe Al_2O_3, $MgAl_2O_4$ $CaMgSi_2O_6$
			C/O > 1
(C)	$^{12}C(+)$, $^{16}O(+)$, $^{25,26}Mg(\pm)$ $^{26}Al(+)$, $^{29}Si(+)$, $^{30}Si(\pm)$ S(n), Ca(n), Ti(n), Fe(n)		C, TiC, SiC, Fe CaS, Al_2O_3 $MgAl_2O_4$, $CaTiO_3$
		(S + Si)/O < 1	(S + Si)/O > 1
(O)	$^{16}O(+)$, $^{24}Mg(+)$, $^{28}Si(+)$ $^{36}S(-)$, $^{40,42}Ca(+)$ $^{46}Ti(+)$, Fe(n)	Al_2O_3, $CaTiO_3$ $Ca_2(Al_2,MgSi)SiO_7$ Fe, $CaMgSi_2O_6$, CaS	CaS, Fe, Al_2O_3 $Ca_2(Al_2,MgSi)SiO_7$ $CaMgSi_2O_6$
(Si)	$^{32}S(+)$, $^{40}Ca(+)$	Fe, CaS	

(−) Possible depletion relative to other stable isotopes and solar abundances; (+), possible enhancement relative to other stable isotopes and solar abundances; (*n*), possible enhancement of neutron-rich isotopes due to neutron capture. (±), Indicates uncertainty in the production relative to other stable isotopes.

*Solar nebula conditions: 10^{-3} atm pressure and either $T > 1{,}430$ K, C/O < 1 or $T > 1{,}300$ K, C/O > 1 and otherwise solar[12] composition.

components, 'last-event' supernova gas and dust, may be mixed into the protosolar cloud when the shock wave from this supernova collides with the cloud and initiates its collapse. We note here, in reference to the problem of producing observable isotopic anomalies, that it may be easier for the 'shrapnel-like' grains from the supernova to penetrate to the interior of the cloud than for supernova gas. This gas, part of which mixes by Rayleigh–Taylor 'interfingering' at the interface between the expanding supernova shock front and the protosolar cloud, may mostly just pass around the exterior of the collapsing presolar nebula. In addition, the time required for injected supernova gas to completely mix with nebular gas may be so short that production of non-radiogenic isotopic anomalies with supernova gas alone might be precluded.

The currently accepted model[6] of presupernova stars pictures them to be composed of several layers. The outer layer has roughly 'solar' composition, while successive interior shells have compositions corresponding to the products of static hydrogen, helium, carbon, oxygen and silicon burning, respectively. The supernova occurs when the presupernova core collapses, and a shock wave explosively burns and ejects the outer layers of the star. In some stars, however, the shock wave may not cause significant explosive processing. Because the most complete estimates of the composition of supernova ejecta are explosive burning calculations, we assume that these ejecta contain zones composed, successively, of the products of explosive hydrogen, helium, carbon, oxygen and silicon burning. These zones are hereafter referred to as the (H), (He), (C), (O) and (Si) zones.

Table 1 shows, for each explosive burning zone, the isotopic compositions[7-9] of the major elements that are decidedly non-solar. Entries are of three types: first, the oversynthesis of one or more isotopes of an element, relative to the others, compared with solar isotopic abundances (namely ^{32}S, ^{33}S, ^{40}Ca and ^{42}Ca in the (C) zone); second, the survival of only one isotope of an element (namely ^{16}O and ^{24}Mg in the (O) zone); or, third, the enhancement of the neutron-rich isotopes of an element relative to solar abundances due to neutron capture during explosive burning or the static helium burning[10] phase that preceded explosive carbon and oxygen burning (namely Ti in the (He) zone).

To discover what minerals could condense in supernova ejecta, equilibrium condensation calculations for each of these zones have been performed[11]. The results for 10^{-8} atm pressure and different C/O and (S + Si)/O ratios are also shown in Table 1. We have listed, for reasons discussed below, only those minerals that are also condensible at 10^{-3} atm, assuming either that $T > 1{,}430$ K and C/O < 1 or $T > 1{,}300$ K and C/O > 1, and otherwise solar[12] abundances. The calculations are not very sensitive to pressure changes. The most important compositional parameter is the C/O ratio, or, in the (Si) zone, the (S + Si)/O ratio. Grains condensed from a given zone will have an isotopic composition characteristic of that zone and are hence capable of carrying that composition into the presolar nebula. But it is not at all certain that grains can form in expanding supernova ejecta. Preliminary estimates[11] suggest that grain condensation is only possible if the shock wave that explosively burns and ejects the matter is relatively weak. If grains do form these results indicate their probable compositions.

As the collapse of the presolar nebula proceeds, the pressure and temperature rise. If isotopic anomalies are to be carried into the Solar System in grains, these grains must be able to survive, that is, their composite minerals must be condensible in this physical environment. We are primarily interested in Ca-rich inclusions of C3 chondrites, which seem to have formed in a nebular region that had a maximum pressure of about 10^{-3} atm and a roughly solar[12] composition. The maximum temperature, T_{max}, that this region reached must have been greater than the condensation temperature of forsterite[11], 1,430 K, because the bulk chemical compositions of the Ca-rich inclusions are similar to those calculated for the pre-forsterite condensate and dramatically different from the post-fosterite composition. If $T_{max} > 1{,}742$ K, no major O-bearing mineral could survive. But corundum (Al_2O_3), perovskite ($CaTiO_3$), melilite [$Ca_2(Al_2,MgSi)SiO_7$], spinel ($MgAl_2O_4$) and diopside ($CaMgSi_2O_6$) could survive if $T_{max} < 1{,}742$, 1,681, 1,625, 1,530 and 1,435 K, respectively. Because all these minerals could condense in at least two supernova zones, isotopic anomalies in the elements O, Mg, Si, Ca and Ti may eventually be observable in Ca-rich inclusions.

Excess ^{16}O (ref. 13) and ^{26}Mg have been observed in these inclusions and could have been carried into the solar nebula in grains condensed in the (C) zone (Table 1). In addition, excess ^{16}O is also produced in the (O) zone. Lee *et al.*[2] found that there is a positive linear correlation between the excess ^{26}Mg and the Al/Mg ratio, that is, the data define an Al–Mg isochron. Clayton *et al.*[13] found the amount of excess ^{16}O to be fairly constant within a given phase, even from samples taken from different inclusions. Both observations may be easier to understand on the basis of a gaseous rather than a crystalline source of these anomalies. But textural[14] and trace element[15] evidence imply that these inclusions were at least partially melted during or after their formation. Since diffusion in silicate melts is more rapid than in crystalline silicates, all phases crystallising from or equilibrating with a melt would tend to have the same isotopic composition, thus obliterating any previous distribution that could be used to ascertain the source of these anomalies. Those phases which did not melt would be expected to have different isotopic compositions. Experiments[16] have shown that spinel and pyroxene have higher minimum melting temperatures in this system than melilite and anorthite. Observations[13] show that the spinel and pyroxene of Ca-rich inclusions have greater concentrations of excess ^{16}O than melilite, by about a factor of four. This could be explained by a partial melting of the inclusions at a time when there was less excess ^{16}O in the ambient gas than in the inclusion. On the same grounds, one could expect deviations from the Mg–Al isochron to occur. But, the higher melting point phases (spinel, pyroxene) have such small Al/Mg ratios that relatively large differences in their initial $^{26}Al/^{27}Al$ ratios would, considering the experimental uncertainty[2], be unobservable. Thus, the determination of the source of the Mg and O anomalies will be difficult since we may not see the original distribution of ^{26}Al and excess ^{16}O.

One other distinction remains between the Mg and O anomalies. While the ^{26}Al has to be associated with a nucleosynthetic event that occurred within a few million years of the Solar System's formation, the observed excess ^{16}O does not. Since the (C) and (O) zones produce excess ^{16}O, either 'old' presolar grains or 'last-event' supernova grains could have carried excess ^{16}O into the presolar nebula. But, if grains cannot form in supernova ejecta, the only remaining way, in our scenario, to inject excess ^{16}O is through last-event supernova gas.

The ^{22}Ne anomaly[14] observed in C1 chondrites may have been produced by 2.6 yr ^{22}Na-bearing presolar grains condensed in the (He) zone[19]. In the solar nebula these grains vaporise if $T_{max} > 1{,}000$ K. But evidence[20] suggests that C1 chondrites may have formed in nebular regions where $T_{max} < 400$ K; if decay-produced ^{22}Ne can be retained in or on these grains at this temperature, incorporation of excess ^{22}Ne into C1 chondrites may occur. But, irradiation[17] in the early solar nebula could also produce excess ^{22}Ne with energy requirements far less stringent than those for the production of ^{26}Mg by irradiation.

What minerals could survive in the presolar nebula if the composition was solar except for a C/O ratio > 1? Enstatite chondrites apparently condensed in such a region[21]. Unfortunately, less is known about the mineralogical history of enstatite chondrites, so no limits on T_{max} can at present be imposed. Calculations[11] show that if $T_{max} > 2{,}025, 1{,}930, 1{,}745, 1{,}458, 1{,}400$ and 1,390 K, respectively, TiC, C, SiC, Fe_3C, AlN and CaS could survive: all of these phases can be condensed in at least two supernova zones (if $C/O > 1$ in the appropriate supernova zones). Thus, C, N, S and Fe, in addition to Mg, Si, Ca and Ti, isotopic measurements could potentially be key indicators of which supernova zones have been sampled. The C^{12}/C^{13} ratio could prove very important in this respect, since this ratio should be less than its solar value if the (H) zone is responsible, while if presolar grains from the (He) and/or (C) zones are incorporated in enstatite chondrites this ratio should be greater than its solar value.

Before the discovery of the ^{26}Mg anomaly, it was thought that the last nucleosynthetic event affecting the Solar System occurred about 10^8 yr before its formation[22], which is the interval between the production of the r-process radioactive parents (^{129}I, ^{244}Pu) of Xe and the retention of daughter Xe in the meteorites. Assuming that the anomalous ^{26}Mg is the *in situ* decay product of ^{26}Al, the Mg timescale is about 10^6 yr. There are at least two explanations for this discrepancy. First, ^{26}Al, ^{129}I and ^{244}Pu may not have been produced in the same nucleosynthetic event, but in separate events 10^8 yr apart. The latter event made ^{26}Al, but no r-process nuclei (or at least its r-process material did not get into the solar nebula). The incorporation of Al, I and Pu occurred about 10^6 yr later. The second explanation is that these three nuclei were all made in the same (last) event, but somehow Xe was unable to be retained by meteorites until 10^8 yr later, possibly because this region of the presolar nebula or the meteorite parent bodies remained too hot. A search for ^{235}U anomalies due to the decay of ^{247}Cm might resolve this problem[23]. ^{247}Cm (half life 1.54×10^7 yr), ^{129}I (1.7×10^7 yr) and ^{244}Pu (8.3×10^7 yr) are all r-process nuclei. The U timescale's turning out to be of the order of the Xe timescale would be evidence in favour of the first possibility since U is a refractory element and does not diffuse out of meteoritic minerals as readily as gaseous Xe.

It seems, therefore, that a last-event supernova provides a consistent explanation of the observed isotopic anomalies. Condensation sequences for supernova ejecta imply that presolar grains may be a useful part of this picture.

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Three-dimensional model of membrane-bound ribosomes obtained by electron microscopy

P. N. T. Unwin

MRC Laboratory of Molecular Biology, Hills Road, Cambridge, UK

A low-resolution three-dimensional map has been obtained from crystalline arrays of membrane-bound eukaryotic ribosomes. It shows both ribosomal subunits to be adjacent to the membrane surface, attached to it by a part protruding from the large subunit.

MOST eukaryotic cells have two populations of actively synthesising ribosomes which are distinguishable morphologically according to whether they exist free in the cytoplasm or are bound to membranes, normally the endoplasmic reticulum. In general, the two populations synthesise different sets of proteins. One function of membrane-bound ribosomes, originally discovered from