SCIENCE NEWS OF THE WEEK

Evidence for an Extinct Superheavy Element

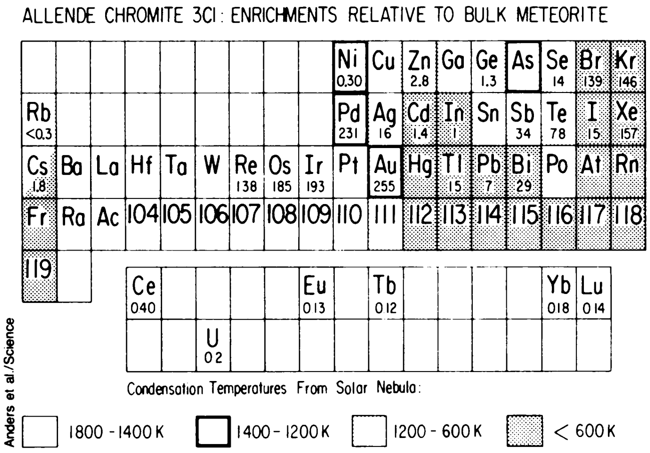
The search for the heavier transuranic elements, atomic numbers 111 to 119, is predicated on the belief that they can actually exist or could have existed in the universe. The assumption is that they are not merely clever extrapolations of the properties of the columns in the periodic table into a realm that for some reason cannot really exist. Concrete evidence of the present or past existence of one or more of the hypothesized elements would strengthen the case.

Five scientists from the University of Chicago, Edward Anders, Jacques Gros, H. Takahashi, John W. Morgan and H. Higuchi, propose that a sample of one of these widely sought elements, element 115 (or 114, 113), once existed in the Allende meteorite that fell in northern Mexico in 1969.

The geochemistry of meteorites is extremely complex, and a short presentation of the chain of reasoning must necessarily be oversimplified. Full details are given in the Dec. 26 SCIENCE.

The argument begins with the presence of a trace of xenon in certain inclusions in the meteorite, a trace up to 180 times as rich as in the bulk of the meteorite. Xenon can be a product of the fission of more than one element heavier than itself. This xenon is found somewhat anomalously in places enriched in noble metals and volatiles, which happen to be chemical congeners of elements 107 to 111 (the noble metals) and elements 113 to 118 (the volatiles), but not enriched in congeners of the actinides, among which the usual progenitors of fission-product xenon are found. So the progenitor of this xenon was most likely a noble metal or a volatile element, not an actinide, and that points to the noble metals and volatiles among the heavy transuranics.

The trace elements are found in a mineral designated Q by the researchers, and the next part of the argument depends on the chemistry and condensation history of this Q. The basic constituent of Q is apparently an iron-chromium sulfide. The history of its formation began when the solar nebula had a temperature of about 1,200 to 1,400 degrees K., and iron-nickel grains containing chromium, gold and palladium condensed on platinum metal nuclei. As things cooled down, a chain of condensations and reactions among the condensates led to a situation in which, probably near a temperature of 450 degrees K., "some part of the chromium formed a sulfide (Q) in intimate association with chromite, which trapped heavy noble gases and volatile-chalcophile elements [elements that have an affinity for sulfur]: selenium, tellurium, bromine, iodine, tantalum and the progenitor of fission xenon."



Anders et al/Science

Enrichments of chemical congeners of superheavy elements 107 to 111 and 113 to 118 in one inclusion of the Allende meteorite. Numbers in the boxes are ratios of the amount of the given element in the inclusion to the amount in the bulk of the meteorite. Shading indicates range of the element's condensation temperature.

From this, the analysts conclude that the progenitor of the xenon was chalcophile and condensed from the nebula with a sulfide. Furthermore that sulfide was a rare iron-chromium sulfide (0.04 percent of the meteorite) rather than the more abundant iron-nickel sulfides (6 percent of the meteorite).

The criterion of volatility alone could point to any element from 111 to 119, but the preceding characteristics allow certain restrictions to be made. Arguments from analyses of another meteorite that shared excess xenon had thrown out elements 117 to 119, and this work adds stronger reasons for excluding them.

To further weed out unlikely candidates from the remaining range, 111 to 116, the researchers consider which of them are likely to condense as sulfides rather than as free metals, and specifically which condense as sulfides near 400 or 500 degrees K. The most likely candidates turn out to be 113, 114 and 115 with a possible slight preference for 115.

The data can be used to set an upper limit on the amount of the superheavy element that might still be present in the meteorite. This comes to 55 billion atoms per gram, appreciably less than the 3,200 billion atoms per gram that must have decayed to produce the present abundance of xenon in the sample. From this, the Chicago group arrives at a half-life of less than 770 billion years, but they caution that the figure is based on an assumed cross section of the progenitor for fission induced by bombardment with thermal neutrons. Other assumptions could lead to a higher value for the half-life. □

Our galaxy has a central radio source

A number of galaxies exhibit radio sources at their centers. Often these central sources appear to be associated with lobes of radio-emitting matter outside the optical galaxy but seemingly ejected from it. If some galaxies can have radio sources at their centers, the question arises whether they all can, and specifically can our own galaxy?

In the Dec. 1 ASTROPHYSICAL JOURNAL LETTERS four astronomers from the Owens Valley Observatory of the California Institute of Technology report the discovery of such a source at the center of our own galaxy. They used a very-long-baseline interferometer composed of a telescope at Owens Valley Observatory (near Bishop, Calif.) and one at Goldstone, Calif., to resolve the direction of the source and to place at least an upper limit on its size, 0.02 seconds of arc or a linear dimension less than 20 billion miles. The Owens Valley group say this is probably a redetection of a source that B. Balick and R.L. Brown found in March 1974 but could not resolve.

The brightness temperature of the source (the temperature that a body would have to have to generate the observed flux by thermal means) is about 30 million degrees K. The body appears to be putting out energy at a rate of 10^{33} ergs per second. Because of the high brightness temperature the observers suggest that the mechanism for production of the radio waves is in fact not thermal. The source also appears to vary its flux over time; it was undetectable to VLBI observations in June 1974.

As galactic-center radio sources go, this one is fairly small and weak. Compared to those of the really strong radio galaxies, it has about one ten-millionth of the radio luminosity and one-tenth the size. A