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TIGER: Progress in Determining the Sources of Galactic Cosmic Rays

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The Trans-Iron Galactic Element Recorder (TIGER) is a 1-square-meter detector system composed of scintillators, Cherenkov detectors, and scintillating optical fibers, which gives excellent resolution of individual elements in the cosmic rays. With two high-altitude balloon flights over Antarctica, TIGER accumulated fifty days of data on the elemental composition of the rare galactic cosmic rays heavier than Ni, measuring the abundances of Cu, Zn, Ga, Ge, Se, and Sr, as well as the more abundant lighter elements. After accounting for fragmentation of cosmic rays as they propagate through the Galaxy and the atmosphere above the detector system, the source material appears to be a mixture of about 80% "standard" Solar-System composition and 20% ejecta from massive stars. This mixture supports a model of cosmic-ray origin in OB associations, as has previously been inferred from the isotopic composition of the more abundant elements, Ni and lighter. These TIGER data also support a cosmic-ray acceleration model in which elements present in interstellar grains are accelerated preferentially compared with those found in interstellar gas. This emerging model of cosmic-ray origin and acceleration will be further tested with a similar but much larger instrument that will give much better statistics, improve the precision of TIGER'S studies and allowing more rare elements to be studied; Super-TIGER development is beginning now, leading to its first balloon flight in December 2012. The TIGER investigation is a collaboration among scientists at Washington University in St. Louis, NASA Goddard Space Flight Center, California Institute of Technology, Jet Propulsion Laboratory, and University of Minnesota. Principal funding for this research was from NASA under grant NNG05WC04G. We also acknowledge the excellent work of the staff of the Columbia Scientific Balloon Facility, the NASA Balloon Program Office, and the NSF Office of Polar Programs.