MINERALOGY AND TRACE ELEMENT CHEMISTRY OF THE ELIZABETH (ILLINOIS) AND FAIRBURN (SOUTH DAKOTA) IAB IRONS. P. P. Sipiera[1,2], A. J. Irving[3,1], S. M. Kuehner[3], G. Jerman[4], G. Chen[5], P. Strickland[5] and C. D. K. Herd[5] [1]Planetary Studies Foundation, Galena, IL (psipiera@planets.org), [2]Field Museum of Natural History, Chicago, IL, [3]Earth & Space Sciences, University of Washington, Seattle, WA, [4]NASA Marshall Space Flight Center, Huntsville, AL, [5]Earth & Atmos. Sciences, University of Alberta, Edmonton, Canada.

Introduction: The history of discovery and documentation of iron meteorites is commonly accompanied by interesting stories about specimens found under unusual circumstances, regarded initially as something else, or kept as heirlooms (only to be discovered much later by chance). Such elements infuse the stories surrounding the two USA iron meteorites described here.

Elizabeth: The specimen was purchased by an anonymous collector in August 2010 at an estate sale in Elizabeth, Illinois with an assortment of other unrelated artifacts. The deceased original owner is said to have found it on his local farm in the 1950s. It is an irregular 732 gram mass with brown weathering patina on most surfaces, except where some hacksaw cuts had been made to reveal the silvery metallic interior. Etching of polished interior surfaces with ferric chloride solution revealed an oriented intergrowth texture of FeNi metallic grains and black, elongate cohenite-rich grains (see Figure 1).

Figure 1. *Etched cut surface of Elizabeth main mass showing blades of kamacite (light gray), taenite (medium gray) and cohenite (black). Width = 5 cm.*

The predominant phase is kamacite with accessory schreibersite and taenite (as angular or "wispy" grains). The elongate ovoid grains (up to 3 mm long by 1 mm wide) are composed of cohenite + low-Ni kamacite + minor low-Ni taenite, and occur within kamacite grains; both show alignment in several different directions. The porous nature of the cohenite (see Figure 2) is not understood – perhaps these cavities were filled originally by graphite or another phase, which has decomposed or plucked out.

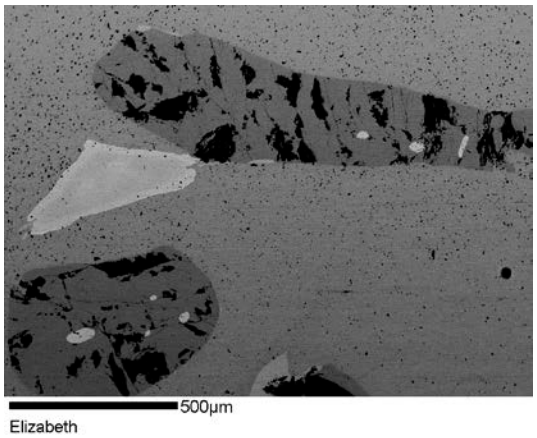


Figure 2. *Back-scattered electron image of a polished surface of Elizabeth. Cohenite (dark gray with black cavities), taenite (bright), kamacite (medium gray).*

Fairburn: The specimen was found in 1907 by Mr. Otis Roberts in a railroad car transporting gravel for ballast, which had been quarried from fluvial terrace deposits of Pleistocene age on the west side of the Cheyenne River in Custer County, southeast of Rapid City, South Dakota [1]. The original 445 gram mass (see Figure 3) was in the collection of the South Dakota School of Mines, but in 1982 James M. DuPont purchased a 56 gram end portion, on which the present studies were conducted.

Figure 3. *Photo of the original Fairburn mass, length = 6.5 cm (reproduced from [1].*

The original smoothly-rounded, oblate-ovoid, silvery mass with thin weathering patina was found to have a specific gravity of 7.306 [1]. The predominant phase is kamacite (bandwidth 0.37-1.96 mm, mean 1.34 mm, N = 18) associated with minor taenite, plessite and globular or ribbon-like schreibersite. No silicates, sulfides or carbides were found.

Trace Element Chemistry: Representative portions of both specimens were analyzed by ICP-MS at the University of Alberta using North Chile as an internal standard (see Table 1 and Figure 4).

	Elizabeth	**Fairburn**	**Canyon Diablo** [2]
Ni (mg/g)	76.0	78.8	66.5-75.9
Co	5.2	5.3	4.5-4.8
Cr (μg/g)	13	17	18-31
Cu	170	132	135-224
Ga	93.5	76.5	78.7-85.2
Ge	335	255	280-360
As	6.2	6.1	12.2-13.7
Ir	2.1	2.3	2.1-2.5
Pt	6.4	5.2	5.4-7.4
Au	1.44	1.49	1.50-1.57
Sb (ng/g)	370	420	240-350
Re	200	220	210-290

Discussion: Both Elizabeth and Fairburn have Ge and Ir abundances within the ranges for IAB irons (see Figure 4). A thorough comparison with literature data for 70 IAB irons and 17 related solo specimens [3] indicates that both Elizabeth and Fairburn have abundances for most analyzed elements within or close to the known ranges. However, both have Ni contents marginally higher than those for the main IAB group, suggesting that they may be anomalous examples.

An issue with heirloom specimens of IAB irons (and especially 20th century American examples) is whether or not some may represent transported Canyon Diablo specimens. Elizabeth does have similarities to some Canyon Diablo specimens in terms of its mineralogy and cohenite textures, yet its Ga content is anomalously high relative to the 15 Canyon Diablo specimens analyzed by [2], so it may well be a new find from Illinois.

In contrast, the well-documented find story, date of discovery and physical appearance of the Fairburn iron argue strongly against this being a transported Canyon Diablo specimen. Fairburn also is clearly distinct from Elizabeth (and Canyon Diablo) in some elemental abundances (especially Ge and Ga), and we conclude that Fairburn is indeed from a separate ancient fall event.

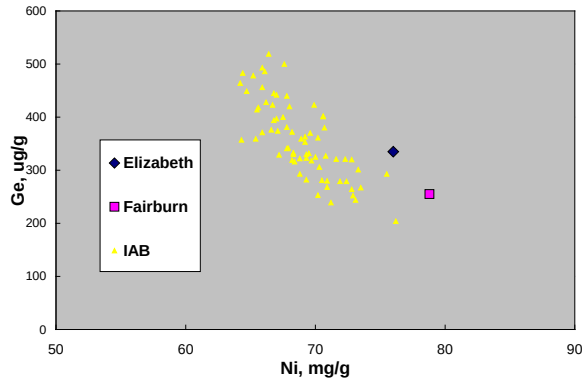
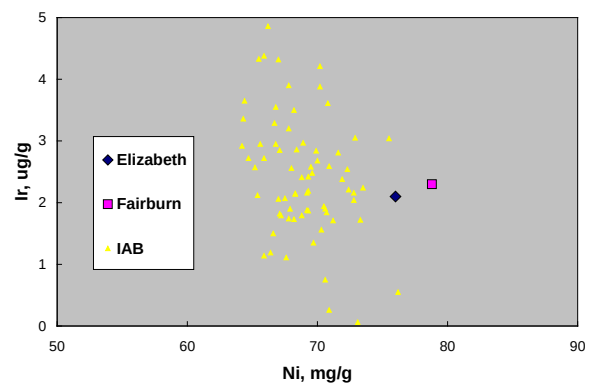


Figure 4. *Plots comparing abundances of Ni, Ge and Ir in Elizabeth and Fairburn with those for other IAB irons [3, 4].*



References: [1] Ziegler V. (1914) *S. Dakota School Mines Bull.* **10**, p. 54-58 and Plate IV [2] Wasson J. and Ouyang X. (1990) *Geochim. Cosmochim. Acta* **54**, 3175-3183 [3] Wasson J. and Kallemeyn G. (2002) *Geochim. Cosmochim. Acta* **66**, 2445-2473 [4] Goldstein J. et al. (2009) *Chemie Erde* **29**, 293-325.