Northwest Africa (NWA) 7034, and its pairings, is a new type of Martian meteorite discovered recently in Western Sahara. NWA 7034, also known as “Black Beauty” because of its dark, shiny appearance (Fig. 1), contains ten times more water than other Martian meteorites. This, combined with its anomalous oxygen isotope values and ancient zircons, makes it an extraordinarily valuable specimen for understanding surface processes, aqueous alteration, and atmosphere–lithosphere exchange reactions that existed on Mars as far back as 4.4 billion years ago. Black Beauty appears to be the first Martian meteorite to match the surface geochemistry of Mars, as seen by landers and orbiters, and as such, it has particular relevance to the current Mars Science Laboratory mission at Gale Crater.

At present, at least six different igneous rock types have been found in the 1–2 kg of the breccia now identified as NWA 7034 (owing to new finds). These include basalt, trachyte, and andesite. These compositions are remarkably similar to the rocks analyzed by APXS on the Spirit Rover at Gusev Crater and more recently with ChemCam on the Mars Science Lab at Gale Crater. Thus Black Beauty is the first tangible sample of the surface of Mars as determined by NASA missions. Secondary alteration products in clasts, spheres, and pebbles of Martian origin are abundant in Black Beauty, and the water-bearing phases include maghemite, ferrihydrite, phyllosilicates, and apatite, which sum to approximately 6000 ppm bulk water—10 to 30 times higher than in other Martian meteorites.

Age determinations on Black Beauty reveal the breccia’s diversity and its complex origin, which likely reflect surface processes operating during a span of a few billion years of Martian history. Rb/Sr dating of the bulk sample done at the University of New Mexico gave an age of ~2.1 Ga; however, bulk Sm/Nd dating done at NASA Johnson Space Center gave an age of ~4.4 Ga. Humayun et al. (2013) reported ancient zircon U–Pb ages of ~4.4 Ga, but they also found a younger population of zircon with ages of ~1.7 Ga, and subsequent studies have found many apatite, zircon, and baddeleyite grains with ages of ~1.4 Ga. Luckily for the chronologists, Black Beauty has populations of apatite and zircon throughout the matrix and in most clasts, which is offering the opportunity to date individual lithic domains, thus revealing the sequence of events that brought this breccia together, prior to its being blasted off Mars around 11 million years ago. Indeed, NWA 7034 is not simply a single meteorite sample; it is more like a Martian geologic field area all contained within one rock—and there is still much to explore!

REFERENCES
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