The validity of EMMA was first tested while predicting the characteristics and total amounts of four key volatiles in the Earth’s atmosphere. The next priority was to test it a second time, looking at a very different element in a very different environment. We selected one the most refractory elements, iridium, which has also a highly siderophile character (i.e., this is an iron “loving” element which will follow the fate of iron during the formation of the Earth’s core). We predicted its concentration in the Earth’s mantle, getting again an astonishingly good fit between predictions and observations.

We thus built up some confidence to use this model in an orderly fashion to make predictions about the still mysterious early history of the Earth, the Moon and Mars, which are probably the best known bodies of the solar system. The model is first used to find new clues about the fate of neon on the Earth, which is one of the major long-standing problems in noble gases geochemistry. It required finding clues about the amazing “sunbursts” history of micrometeorites in the interplanetary medium, where they were implanted for a few 100,000 yr to very high destructive fluences of solar wind helium ions accelerated at speeds of around 400 km/s. Moreover, the simple observation of the micrometeoritic “purity” of the Earth’s atmosphere yields new constraints about key processes effective during the early history of our blue planet, such as the functioning of the Earth’s mantle.

We next move with iridium to the second best known body, the Moon, facing there the stunning problems of the “indigenous” component with a very low Ir content, which was comminuted to make lunar mare soils. Our next destination will be Mars, the third best known body, to consider the fate of another siderophile element, Ni, but also that of S, which also behaved as a strongly siderophile element on the early Earth. The early history of Mars is much less constrained than that of the Moon, but there is a spectacular
assault on Mars with the Mars-Odyssey, Mars-Express-Orbiter missions, and the Mars exploration rovers (Spirit and Opportunity). In particular the Ni and S contents of the Martian soils were measured by the APXS instruments on board both rovers (see below), and we try to predict these contents with EMMA.

One unavoidably hits new problems when moving to unknown boundaries. One of the major objectives of this chapter is to try to convey the feeling that a decisive step in scientific investigation is not only to find credible solutions to these problems, but also to define new questions. They generally open new horizons, but because they also present new, seemingly insurmountable problems, they can cause you to consider quitting science for good! In fact, while working with Spirit and Opportunity, we got stuck with Ni and S. But, we possibly found new clues about the formation of the Martian atmosphere.