Agilent Case Study: University of Aberdeen

Tracing the Effects of Trace Elements

Agilent aids research into environmental processes

Jörg Feldmann directs a laboratory in Scotland that studies rice, barley, seaweed, and pilot whales—among other things, of course.

"We try to answer questions such as why do pilot whales get stranded on beaches? Or why does arsenic accumulate in certain varieties of rice and not in others?" he says.

Feldmann founded the Trace Element Speciation Laboratory at the University of Aberdeen in 2000. An Agilent partner lab, it now includes approximately 20 researchers and collaborates with scientists in Europe, Asia, Africa, Australia, and the Americas.

"We are looking at processes in the environment, especially where metals (and some nonmetals) are involved, with regard to toxicity but also eventuality of elements," he says.

That is, where do these elements end up?

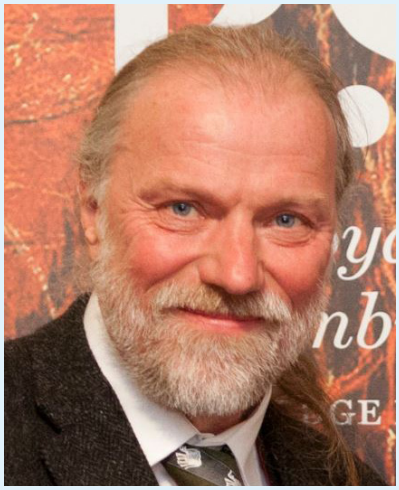
"Organofluorines are increasingly a problem," Feldmann says. "There are some blockbuster statins, for example, that are fluorinated. You take these therapeutic drugs, they pass through your system, and then they go into the toilet. What happens to them?"

For insights and answers, the lab depends of technologies from Agilent, especially inductively coupled plasma mass spectrometers used in conjunction with high-performance liquid chromatography systems.

In fact, Agilent's **triple quadrupole ICP-MS** system has proved indispensable.

"Fluorine, as students learn in the first lesson of ICP-MS, is the element you can't measure because you can't get it ionized. But we developed new plasma chemistry to create a fluorine ion, a positive ion, in the plasma—barium fluoride plus—and that's what we detect," Feldmann says.

"This is quite exciting. It's brand new. So far, nobody else is doing this, as far as I know, and we have already identified new fluorinated compounds using this plasma chemistry with **HPLC** and **ICP-MS** systems from Agilent."



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The lab uses the same Agilent systems for its research into arsenic, selenium, mercury, and other elements.

"We bought two triple quads that make it possible to detect elements that are otherwise very difficult to detect—especially when we want to detect, simultaneously, elements like sulphur and arsenic. We can achieve that very well with the triple quad," Feldmann says.

"We also use electrospray ionization and are not only finding arsenic and sulphur co-eluting peaks but also identifying the molecular species in the rice roots, so we can actually find out why some cultivars trap the arsenic in their roots instead of transporting it up to the grain."

As a result, the Trace Element Speciation Laboratory, working with geneticists at the university, was able to identify the best high-yield, low-risk rice for Bangladesh, where, Feldmann notes, arsenic in the soil and groundwater is a prevailing problem.

Mercury is also becoming a problem in rice, he says—and in pilot whales.

"We have found that some elements, like mercury, travel through the blood-brain barrier and deposit as nanoparticles in the brain of pilot whales, exactly where the center for orientation is," he says. "That might influence their ability to orientate themselves. Or it may inflict deficiencies in selenoproteins, which is related to diseases like epilepsy, and could also cause the stranding of whales."

Then there's the archeological project in which his researchers are looking into how seaweed, a plentiful resource in the area, may have been used historically. Though some are calling it "the veggie of the 21st Century," Feldmann suspects the use of seaweed is not really new in Scotland—just forgotten.

"Seaweed has a unique elemental fingerprint, so we planted bere barley—a very old form of barley that people used here in the north of Scotland, where we have a lot of Neolithic sites—and fertilized with seaweed. We want to find out if we can actually see, in the bere barley, the same elemental fingerprint transferred from the seaweed. Then, in some of these digs, if they find in clay pots some remainders of these ancient barley grains, we can maybe establish how seaweed was used as fertilizer for these relatively poor soils, especially in seaside communities, and how they sustained the agriculture."

For that elemental fingerprint, ICP-MS is absolutely vital, he says.

Feldmann is particularly pleased that the lab has been able to do pioneering work to develop elemental speciation and elemental bioimaging methodologies—and that it has created the reference materials that form the foundation for new legislation regarding contaminants in food.

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