Clear as water

Expert hydrogeologist **Dr Beth Parker** clarifies the finer points of her work characterising the activity of groundwater contaminants in fractured rock environments and describes the progress of the research Centre that she leads in this area

G360 Principal Investigators (from left to right): Beth Parker, John Cherry, Peeter Pehme, Emmanuelle Arnaud, Jana Levison

It has been a productive past year for the G360 Centre. In terms of the work carried out, what do you consider to be the Centre's most important achievements in recent months?

Firstly, we expanded our human resources capacity through the addition of seven PhD-level scientists: one Assistant Professor and six postdoctoral fellows. This added research capacity and expanded expertise has stimulated fresh research thrusts involving new contaminant types (nitrate and chromium) and new types of contaminant threats (shale gas development and electrical transformer stations) in areas of groundwater vulnerability. Secondly, we have expanded our collaboration with other universities, and are currently working with researchers at the University of Waterloo, University of New Brunswick and University of British Columbia in Canada, as well as with international partners in the US, Switzerland, China and Brazil. Finally, we have added new corporate technology collaborators such as ALT in Belgium for data analysis software and Silixa in the UK for fibre optic down-hole technologies, in addition to sponsers such as Dow Chemical company and Boeing.

Why is collaboration so valuable to your research?

The research is focused on field studies in many types of bedrock at numerous locations in North America and beyond, involving a variety of forms of contamination. Therefore, the collaborative linkages are many and diverse because of the broad range of expertise and equipment needed. In addition to the universities mentioned above, we also collaborate with companies that develop and manufacture hardware and software, consulting firms with specialised expertise, and contaminated site owners, some of whom have employees engaged in the research as graduate students. These collaborative ties with industry stimulate advances in acquisition and the processing and modelling of field data, as well as fostering technology transfer. We also work together with regulatory bodies, such as the Ontario Ministry of the Environment and Ministry of Natural Resources, when appropriate.

What advantages are afforded by basing your research at the University of Guelph (UoG), Ontario?

The UoG has historically been the agricultural-focused university of Ontario. This means that large field-based research programmes and established research stations with acreage are available to support a field-based hydrogeology programme. It also features programmes in Water Resources Engineering, Environmental Engineering, and Environmental Science that are expanding undergraduate and graduate education with new infrastructure and faculty to enhance groundwater research and training. Most importantly, however, the main campus sits on top of a highly transmissive bedrock aquifer used by the UoG, the City of Guelph, and nearby surrounding rural communities for drinking water as well as for industrial and agricultural purposes. Hence, the University and its researchers are directly involved in the local bedrock hydrology, with this aquifer serving as a model system for studying all components of the hydrogeologic cycle, with respect to managing and protecting freshwater resources.

In a bid to develop a future generation of groundwater experts, the Centre is involved in a number of postgraduate training and professional courses. How are these structured and what successes have you seen to date?

The emphasis in all training programmes offered by the G360 Centre is on case studies in real field settings that rigorously apply fundamental theory and natural science to the collection of empirical data. Multiple independent and complementary methods and technologies, many of which are invented or advanced by the trainees, are used to collect high-resolution datasets that are exceptionally detailed. These rich datasets are then used by trainees to test and refine mathematical models that ultimately inform remediation plans in the case of a contaminated site, or predict where to locate a new municipal well for a long-term sustainable supply of drinking water. The net result is addressing societal issues by devising innovative ways to understand the system.

What roles and responsibilities come with holding the Natural Sciences and Engineering Research Council of Canada (NSERC) Chair in Groundwater Contamination in Fractured Geological Media?

The NSERC Industrial Research Chair programme leverages government funding with industrial sponsorship, in my case serving to offset the cost of field-based research and thus magnify the outcomes. The Chair position has attracted the attention of international students and collaborators and enhanced the depth and breadth of my research programme. As a Chairholder since 2007, I have been tasked with building research capacity in an area of groundwater research that is important to industry both in Canada and globally.