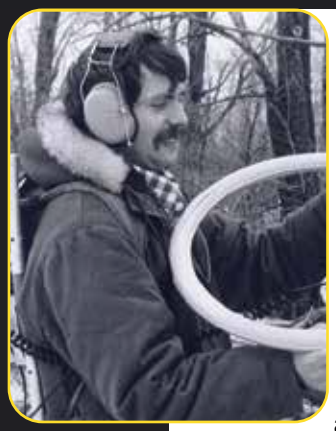

Duncan Crone

James Duncan Crone, 1929-2011, was a pioneering Canadian mining geophysicist, explorationist and entrepreneur. Crone, known and recognised in the mining and exploration community around the globe, was a very innovative, practical-minded geophysicist who made numerous important contributions to the advancement of mining geophysics and to mineral exploration discoveries during his long career.

He was born in Toronto. Following graduation, with a degree in Mathematics and Physics, he joined the remarkable group of innovative geophysicists working for Newmont in Jerome, Arizona under the legendary Dr Arthur Brant. That group included Harry Seigel and Len Collett. Here, the practical application of Induced Polarisation to mineral exploration was born. Later, with co-operation from Newmont, Crone would use what he learned in Jerome to build practical IP and EM instrumentation which were simple to operate and extremely reliable.

In the early 1950s he returned to Canada and joined Radar Exploration where he was involved with magnetic, gravity, and vertical loop EM surveys following up early airborne EM surveys for massive sulphide deposits. One of his achievements during this time was to successfully apply gravity surveys to distinguish graphite from massive sulphides in the Bathurst mining camp.

In recognition of his abilities and the growing importance of geophysics, Duncan was asked to set up a geophysics department at Noranda Mines, serving as Noranda's first Chief Geophysicist from 1956 until 1962. His focus at that time was to develop practical, portable EM systems that could be used to find near-surface massive sulphides. The JEM and the Shootback EM method were invented and developed, constituting great improvements over other instrumentation available at that time. The Shootback method was an ingenious way to remove the effects of topography on tilt-angle EM surveys. A borehole EM system was also developed during this time at Noranda, but borehole geophysics was a difficult concept to sell to sceptical geologists and mining engineers, as Crone would later discover.

In 1962, he founded Crone Geophysics Ltd where the Shootback EM method was further improved and put into production. His innovation and inventiveness led him to produce numerous practical and portable instruments such as the CEM (Horizontal Shootback EM with larger coils than the JEM), the VEM (Vertical Loop EM transmitter hoisted on a mast, with tilt-angle CEM receiver), and the RADEM (VLF receiver). These were sold to a worldwide market. Crone, always close to the action in mineral exploration, was involved with numerous discoveries while consulting for Amoco and Mattagami Lake Mines among others, many of which were based on his picks of priority targets from airborne surveys, and followed-up with his EM instruments.

In the 1970s, as Induced Polarisation became more widely used around the world, Crone also saw the need for a practical, lightweight, easy to operate IP system. This led to the development of a battery-powered IP transmitter and compact receiver which facilitated shallow IP surveys in difficult and remote locations as well as borehole IP surveys.

Realising that there was a growing need to look deeper into the earth, and drawing on early instrumentation and research by Newmont, he began to develop borehole and surface time-domain EM equipment, which he named Pulse EM. The original Crone surface Pulse EM system, developed in 1973, was a small, portable, multi-turn loop and an analogue receiver which was used initially in the Sultanate of Oman where, serendipitously, the first field test outlined three massive sulphide orebodies. This was the first commercially available surface time-domain EM system in the world, and it was an

immediate success. It was soon being used worldwide. The surface Pulse EM gear continued to evolve enabling deeper penetrationwith larger loops and more power (many years later, during his active retirement, Crone visited Oman and the mining operations at the site of the PEM-aided discoveries).

In 1978, the first commercial Borehole Pulse EM system in the world was produced by Crone Geophysics. The borehole method was initially a very hard sell, but he persevered and after a few successes, such as the discovery of an ore lens at a depth of 950 m adjacent to the Corbett mine near Noranda, Crone managed to convince the sceptics that borehole geophysics was a useful, valuable, practical tool. Today, borehole Pulse EM is an integral part of many exploration programs, and has led to the discovery of many deep massive sulphide orebodies.

In 1990, he sold the assets of Crone Geophysics to a renamed company, Crone Geophysics & Exploration, owned by many of his veteran employees, while continuing as President. After retiring in 1993, he continued an active life, undertaking many ambitious trips to various parts of the world.

He presented many papers and wrote numerous case histories in his very readable, straightforward style. In 1987 his paper at the MGLS Symposium entitled *Case Histories of Borehole Pulse EM Surveys* won the Best Paper Award. Other awards included the A.O. Dufresne Award from the Canadian Institute of Mining in 1992 “in recognition of his pioneering development and successful application of geophysics to mining exploration over the last 40 years”, and the Distinguished Service Award from the Prospectors and Developers Association of Canada in 2001 “for his lifetime of work in geophysics and his many important contributions to the advancement of the science.”

Crone was one of the early members of KEGS (Canadian Exploration Geophysical Society) and a long-standing member of the SEG. In 2009, he was recognised as a geophysical pioneer and is included in the roster of notable Canadian geophysicists honoured and commemorated by the KEGS Pioneers Scholarship Fund for education in geophysics.

The prototype Borehole Pulse EM system

The Crone JEM Shootback EM method corrects for topography and identi¬fies conductors in operation.