# V.I Vernadsky: Holistic thinker and geochemical pioneer

W.M.EDMUNDS[1]* AND A A BOGUSH[2]

[1]School of Geography and the Environment, Oxford University, Oxford OX1 3GY, UK (correspondence: wme@btopenworld.com)
[2]Institute of Geology and Mineralogy of Siberian Branch of the Russian Academy of Sciences, pr.Koptyuga 3, Novosibirsk 630090. Russia (annakhol@gmail.com)

Vladimir Ivanovich Vernadsky has only recently become recognised internationally [1,2], despite being regarded as one of the greatest names in science of the 20th century in his homeland Russia. There are several reasons for his lack of renown in the west, but mainly that his most important work *"The Biosphere"* was only fully translated into English in 1997 [1,3]. This book and the ideas it contains are now becoming regarded as one of the seminal scientific works of the last century. It defines the biosphere as a unifying, holistic concept for the earth system at a time when reductionism was the driving motivation in scientific research. Above all, for earth scientists, Vernadsky regarded life as the driving geological force. He also adopted the concept of the 'Noosphere' (the evolution of human thought) to emphasis man's role as a geological agent. His publications foreshadow Gaia theory some half a century later.

This paper, coinciding with the 150th anniversary of his birth celebrates his achievements as a pioneering geochemist through his contribution in mineralogy and crystallography, geology and isotope geoscience, geochemistry and biogeochemistry, chemistry and biochemistry, pedology and hydrology, meteoritics and, the history of science and philosophy [4]. His was the first text on geochemistry [5] and also on hydrogeochemistry [2,6] published in three volumes. Vernadsky's ideas also led to the evolution of landscape geochemistry which was promulgated by his contemporaries and students (Polynov, Fersman, Perel'man *et al*.).

[1] Margulis *et al*.(1998) In: Vernadsky *The Biosphere* Nevraumont Books, New York, 14–19. [2] Edmunds & Bogush (2012) Appl Geochem **27**, 1871-1886. [3] Vernadsky (1977) The Biosphere (Trans. Langmuir DB) Springer NewYork. [4] Vinogradov (1963) Geokhimiya **3** 211-214. [5] Vernadsky (1924) La Géochimie, Paris. [6] Shavartsev *et al*. 2006 Geochem Int, **44** 619-634.

# Water security in low rainfall areas

W M EDMUNDS[1]

[1]Oxford Water, School of Geography and the Environment, Oxford University, OX1 3GY

Humans have shown a capacity over millennia to adapt to living in water scarce areas under changing climatic conditions. Today the challenges of adaptation are still water-based, but more complex due in particular to energy requirements, food security and population growth. Renewable groundwater of adequate quality is the key to water resource security in arid and semi-arid areas. Excessive and uncontrolled abstraction of mainly fossil water has already led to massive depletion of valuable reserves of groundwater in major aquifers worldwide. Access to safe drinking water supplies however remains the primary issue for most of the world's poorest people.

Geochemistry plays a role in both the quantitative and qualitative aspects of water security. Physical parameters such as recharge estimation can best be estimated or validated using simple tools such as chloride mass balance; importantly such techniques are inexpensive and widely applicable. Residence times can be determined by a mix of radiometric and isotopic tracers as well as CFCs. Natural groundwater is widely recognised as the purest and most reliable water resource but its properties need assessment for harmful substances derived from geological sources. Above all, the needs of one quarter of the world's population with no access to safe drinking water and one third without access to sanitation can be addressed often using basic hydrogeology coupled with simple geochemical measurement.

It is argued that rural communities may have greater opportunities for developing water security as compared with many of those in urban areas. The key lies in creating self-sufficient and productive communities based on water prioritisation. This involves *inter alia*, careful conservation and management of renewable groundwater, rainfall harvesting, underground storage - combined with education and training initiatives benefiting rural society. Policies need to be adapted and implemented to ensure that development is based on water renewability.

www.minersoc.org
DOI: 10.1180/minmag.2013.077.5.5