Prof. K. Gopalan

As a graduate student in 1960 in the Physics Department of IISc, Bangalore, Gopalan switched from physics to earth sciences under the guidance of Prof. Venkatasubramanian. His work was on quantitative dating of extraterrestrial (cosmochronology) and terrestrial rocks (geochronology) based on the time dependent transformation of naturally- occurring radioactive (parent) isotopes of some elements into isotopes (daughter) of other elements. His significant contributions in the larger context of earth and planetary sciences over the last five decades are summarized below.

As a postdoctoral associate of Prof. G.W. Wetherill in UCLA, Los Angeles, Gopalan determined Rb-Sr ages of close to 4,600 million years for individual groups of meteorites, thereby validating a few previous model-dependent ages. He was selected for his expertise on meteorites to the team of scientists to analyze the first batch moon rocks from the Apollo 11 mission in July 1969. Although moon samples were harder than meteorites to date, Gopalan succeeded in dating them to give the first indication that the moon was volcanically active in its infancy. The US government invited him, as a Fulbright scholar, to talk on his work on lunar rocks in major Indian cities during the exhibition of a moon rock there in early 1970.

He joined the research group of Prof. D. Lal in the TIFR, Mumbai to initiate geochronological research in India. For this he designed and built a mass spectrometer, as commercial instruments were too expensive. He could, however, try out this instrument only after he moved to the Physical Research Laboratory (PRL) in Ahmedabad in 1974 following the appointment of Dr. D. Lal as its director. Interacting with GSI scientists in the collection of key rocks from Rajasthan, Gopalan discovered very old (Archean) crustal remnants to the east of the Aravalli mountains and a possible ancient tectonic plate margin to the west.

The prevailing view then was that volcanic rocks extruded on oceanic and continental crusts were derived from isotopically distinct mantle segments. Gopalan saw an opportunity to test this dichotomy from strontium and neodymium isotopic ratios in different layers of the volcanic edifice, known as the Deccan basalts, in central India. Measuring these ratios precisely in collaboration with Prof. Macdougall of the Scripps Institution of Oceanography, Dr. Gopalan showed convincingly that the apparent difference between sub-continental and sub-oceanic mantles was an artefact of crustal assimilation by the primary melt in the former case. Another important outcome of this work was the distinctness of the mantle sources of the older Raj Mahal basalts in eastern India and the younger Deccan basalts.

The Deccan volcanic eruption about 65 million years ago attracted global scientific interest, as it was believed to have been triggered by a large meteorite impact and caused the global mass extinction and deposition of iridium-rich clay layer at that time. Dr. Gopalan developed 40Ar-39Ar dating facility involving neutron irradiation of samples to precisely date the basal layers of the Deccan sequence. His results delinked Deccan eruption from a bolide impact. K/T mass extinction and clay layer are now believed to be due to a meteorite impact in the Atlantic ocean close to the US-Mexico eastern border and slightly later than the Deccan initiation.

Realizing that commercial mass spectrometers with much higher precision and sensitivity than possible with home-made instruments were indispensable for sophisticated studies, Gopalan accepted Prof. V.K. Gaur's invitation in 1984 to organize a world class isotope laboratory around a commercial mass spectrometer in the National Geophysical Research Institute, Hyderabad. before leaving PRL, he helped in establishing sophisticated mass spectrometric facilities for his colleagues to pursue other types of research.

Dr. Gopalan built a clean chemical lab in NGRI for contamination-free chemical processing of samples to preserve their isotopic integrity, and introduced Sm-Nd analyses to complement Rb-Sr analyses.

Dr. Gopalan's focused on mantle-derived rocks like kimberlites and carbonatites in his new lab. He showed that diamond-bearing kimberlites in Andhra Pradesh (Vajrakarur) and Madhya Pradesh (Panna) were episodically emplaced just at one time – 1100 million years ago. He discovered two spatially very close carbonatite bodies in Tamil Nadu (Sevatur and Hognekal) but which were emplaced at two incredibly-different times- 2400 and 700 million years ago. Their intial Sr and Nd ratios imply that both were derived from the same mantle source that evolved in isolation for as long as 2000 million years.

Dr. Gopalan reported a precise Sm-Nd age of 4.570±0.023 by for a recently fallen meteorite (Piplia Kalan) in the international conference in Ahmedabad in 1997. Prof. Wasserburg, a giant in the subject, commented from the audience that if the age result was correct, the meteorite should contain evidence of the earliest solar system events. Dr. Gopalan's PRL colleagues indeed found that long elusive evidence later, validating the very old age of Piplia Kalan.

Sedimentary rocks are far more difficult to date reliably than igneous and metamorphic rocks because of their detrital origin. As an emeritus scientist after his retirement 1998, Gopalan has reliably dated key horizons in the lower and upper Vindhyan sequence.

Dr. Gopalan's enduring satisfaction was to have empowered many young Indian students to pursue world-class research in isotope geoscience. He hopes that his concise book on radiometric dating (Cambridge University Press, 2017) will stimulate many young Indian students to take up a serious study of isotope geology.