

fields. Any story of origins may have to fit with the generally accepted picture (if there is one) based on accepted archaeological, historical, linguistic and sociological studies. When it comes to India, the book misses out in this respect. Nonetheless, his stance and arguments for considering sample identity in various medical studies are in the right direction to go. It would be wrong to blame him for a supposedly 'racialist' attitude. In India, most researchers, and the so called 'elites' generally, are against using population or caste identity in genetic studies. This is ill-advised. Given the prevalence of castes, knowledge of its association with geographical, linguistic and cultural traits, or with disease prevalence, it helps in better interpretation of the past and offers help for the future.

Now for a word of caution. The new field of NGS technology has led to hype (in terms of what it can achieve), hero worship (of its practitioners) and the commercialization of science (ever-more present). Instrument manufacturers and companies that claim to uncover ancestries are becoming rich. They are part of today's 'knowledge economies' that co-opt workers from developing countries as collaborators; researchers from poor countries as cheap labour and small laboratories gleefully piggy-back on them for high index publications and thus promotions. Academic and research institutions in developing countries, India specifically, purchase and showcase the expensive, state-of-the-art equipment needed to implement NGS methods. But they do not make use of the equipment. The reasons are many: lack of suitable infrastructure for maintenance, lack of appropriate funding (consumables are expensive, as is the cost of updating technology and equipment), poor computational power and trained manpower, inefficient administrative procedures,... one can go on. As a result, with the exception of a small minority, Indian laboratories cannot do work that is novel or original, let alone research that compares with that in developing countries. The lack of comradeship and collaborative spirit in our science is another handicap. My guess is that in India, NGS equipment is utilized at 5% capacity in 90% of the places where that has been installed.

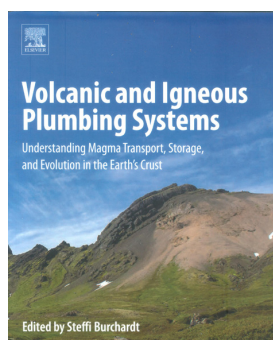
At the end of reading this demanding book, one asks if the author has succeeded in telling our story. In large

measure, yes. But he could have downplayed his pride on his achievements, behavioural modernity and ancestry. He may have the right to feel proud as human being. But he could have been more generous in quoting, refuting or indicting. As the Director of 'The Genographic', Indian chapter, it pained me to read Reich's utterances on the tree metaphor, demic expansions and the Genographic project. One should appreciate the context and background in which studies are made and stories are told.

I have no hesitation in recommending this book to any serious reader, who wants to learn about the history of mankind, while taking sections such as the history of India with a pinch of salt. With its well referenced citations, notes and quotes, the book will be of use in teaching programmes in modern archaeology, anthropology and population genetics, both in developed and developing countries. A better understanding of human past is to be welcomed in an age in which findings based on modern science have to contend with people with closed minds, sometimes fanatics, who refuse to see the evidence or engage with those of different views.

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Volcanic and Igneous Plumbing Systems: Understanding Magma Transport, Storage, and Evolution in the Earth's Crust. Steffi Burchardt (ed.). Radarweg 29, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. 2018. xii + 341 pages. Price: US\$ 140.

Volcanoes are some of the most fascinating features not only on the earth but also on some of its counterparts in our own

solar system. For example, Olympus Mons on the Mars is the tallest yet known volcano in our solar system with a height almost three times that of the Mount Everest. Volcanoes are regarded to be the cradle for the development and evolution of life on the earth as well as edifices which have brought countless species (including giant dinosaurs) close to and/or complete extinction. The 1883 Krakatoa volcanic island explosion in Indonesia, where 70% of the island's area and ~35,000 of its inhabitants vanished overnight, and the volcanic ash buried cities of Pompeii and Herculaneum (dating back to AD 79), in Italy serve as chilling testimonies of catastrophic effects of the volcanic eruptions. Over the years, volcanology has emerged as the science of studying volcanic eruptions, their types, products and landforms with an ultimate goal of understanding the physics and chemistry of their mechanism and to forecast the eruptions. However, such an understanding is not straightforward as much of their plumbing systems – termed as volcanic and igneous plumbing system (VIPS) or magma plumbing system – are hidden below the volcanic structures and are not directly and easily accessible. The plumbing system comprises dykes, sills and larger magma bodies that form the pathways and supply system of magma beneath active volcanoes in the earth's crust. Their understanding requires a multi-disciplinary approach involving geological, geochemical, geophysical and geodetic techniques which can help in interpreting what is happening prior to, during and after a volcanic eruption.

The book under review is an attempt to summarize state-of-the-art of our present knowledge about magma transport and storage in various VIPSs and highlight the systematic approaches involved by detailing these aspects in twelve chapters. In the very first chapter dealing with introduction to the volcanic and igneous plumbing systems, Steffi Burchardt has provided an historical overview as to how the concept of magma plumbing system evolved right from the first attempts made by none other than James Hutton, father of geology, in late 18th century. The chapter provides a glimpse of emergence of VIPS as a separate scientific discipline. The author has interestingly brought out different perspectives on the magma plumbing systems from the viewpoint of a child, a

non-geologist, a geophysicist, a volcanologist, a seismologist, a structural geologist and a petrologist. An overview of the various chapters is also provided.

A. R. Cruden and R. F. Weinberg (Monash University, Australia), in chapter 2, have provided insights into the aspects of magma segregation, ascent and emplacement in deep continental crust. The authors offer explanations for different magma plumbing systems ranging from tabular intrusions and mush columns to flowing diapirs. Detailed discussions on segregation and extraction of magma from migmatitic sources have been dealt with aided by clear pictures and governing equations. Contrasting contemporary views on magma ascent through crust as a result of diverse ranges of approaches (structural/physical versus petrological/geochemical) are also reviewed.

Chapter 3 by Janine Kavanagh (University of Liverpool) begins with a brief discussion on the various methods deployed to study dyke propagation. Different aspects of dyke geometry such as orientation, host deformation and magma flow are addressed with field evidences (Swartruggens kimberlite dyke swarm South Africa) as well as laboratory experiments. Integrated numerical modelling and experimental works are shown to be much needed to explore the mechanisms of dyke emplacement.

Eroded volcanoes are characterized by the exposure of sheet intrusions that provide significant insights into the VIPS and lava flow feeding mechanisms. Hundreds to thousands of magmatic sheet intrusions can be found in such eroded volcanoes worldwide. Chapter 4 by Steffi Burchardt and others discusses the mechanisms of volcanic rift zone development along with cone sheets emplacement and geometry. An important aspect covered in this chapter is the discussion on the controlling parameters of radial dyke swarms which are an important part of the volcanoes on the earth as well as other terrestrial planets. The authors conclude that local volcano loading stress can play a key role in controlling the patterns of cone sheets and radial dyke swarms that subsequently become dominant in multiple rift zones. Clear field examples, backed up with beautiful field pictures, from the exposed radial dyke swarms and volcanic conduits from the Canary Islands and Central Iceland have been provided.

Dykes and sills constitute the main magma pathways. Whereas the study of dyke swarms has been given much attention, research on sills remains somewhat limited in comparison. Sills are important constituents of the sedimentary basins as evident from the seismic surveys for hydrocarbon exploration. Chapter 5 by O. Galland (University of Oslo) and 13 others begin with the various formation mechanisms and morphology of sills. With the help of clear pictures, the authors attempt to explain various models proposed for the sill propagation. These include linear elastic fracture splitting (LEFM) model, brittle and ductile faulting model and fluidization model. An important aspect covered is the economic relevance of sills that include their effects on the hydrocarbon exploration. The chapter ends with a field example from the Golden Valley Sill Complex, Karoo basin of South Africa.

The chapter 6 (Sven Morgan, Iowa State University) is related to the laccoliths and mid-crustal plutons emplacement mechanism models. The chapter begins with an example from the Henry Mountains, Utah, which is the type area of laccoliths. Another example from Jurassic Maiden Creek Sill and Trachyte Messa Sill, USA is provided. Pascal's principle (which states that fluid pressure changes are transmitted through the fluid everywhere equally so that the pressure remains unchanged), has been used to develop a model for the growth of laccoliths. Mid-crustal intrusions emplacement is also discussed by the application of the Pascal's principle with detailed examples from the Birch Creek Pluton, California.

Magmas are essential products of plate tectonics as well as plume tectonics and therefore, their role in the VIPS is an important aspect to assess, which is the objective of chapter 7 by B. V. W. de Vries and M. V. W. de Vries (University of Blaise Pascal, France). The chapter describes magmatism and plumbing system at divergent (mid-ocean ridges and continental rifts) and convergent (ocean subduction zones and continental collision zones) geodynamic settings. Additionally, aspects related to the magma transport and storage in the continental intraplate settings, which are the zones of mantle plume-related hotspot magmatism, are also touched upon.

The magmatic history, right from the birthplace in mantle to their emplace-

ment or storage zone within the crust, is locked up in the rocks. Petrogenesis of magmatic systems can be understood from the crystal population and textural study in the volcanic rocks. This important approach is described in chapter 8 by Dougal Jerram (University of Oslo) and others. Key magmatic processes such as magma mixing and mingling, stoping, assimilation, transport rate and emplacement mechanisms are demonstrated to be inferred through crystal population and textural studies. Components of crystal populations (phenocrysts, antecrysts, xenocrysts and microlites) and crystal zoning patterns represent different levels of crystallization at variable pressure, temperature and oxygen fugacity. The authors show that the shapes of crystals and crystal size distributions (CSD) along with the textural data provide important insights into the study of the magma plumbing system. Recent advances in instrumental techniques such as 3D X-ray tomography, micro CT analysis, CL imaging, SEM and EBSD can help in understanding element diffusion processes and their rates. The chapter ends with a note on the future scope of 4D observations using advanced techniques to explore the VIPS.

The chapter 9 by A. Delcamp (University of Brussels) and others discusses the lateral and vertical collapses or destroying mechanism of volcanoes. It has been shown that the volcano edifice deformation can be either short or long termed. Short-term instabilities are caused by shallow magma emplacement and glacier melting, whereas the long term instabilities are caused by faulting, gravitational deformation, hydrothermal alteration, long term magma emplacement and erosion. Apt pictures have been provided to illustrate these mechanisms. An important question addressed here is how readily the volcanoes rebuild after collapse? The chapter ends with field examples from Mt St Helens, Oregon, USA and Tenerife Island of Canary Archipelago in Spain.

The chapter 10 by Ben Kennedy (University of Canterbury) and others is devoted to the caldera volcanoes and VIPS associated with them. With well-illustrative sketches, the conceptual model of volcanic plumbing system beneath caldera volcanoes are discussed. The authors conclude that the state of magma beneath a caldera is transient during its life cycle. Detailed field example of Lake City Caldera, USA, is provided at the end.

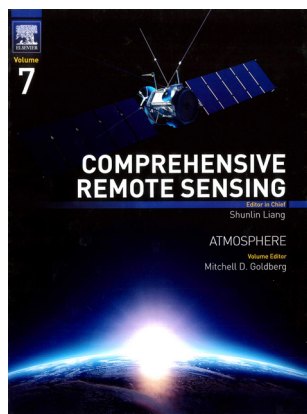
The chapter 11 by F. Sigmundsson (University of Iceland) and 19 others is all about how the movement of magma in VIPs affect the associated ground deformation and unrest. Different techniques such as Global Navigation Satellite System (GNSS) geodesy are shown to measure ground deformation caused by the magma transfer. Detailed illustrations from the volcanoes in Iceland at different time zones (2010 Eyjafjallajökull eruption, 2014–15 Bárðarbunga eruption) preceding several years of unrest have been provided.

The epilogue (chapter 12 by Steffi Burchardt) focuses on the future scope of the state-of-the-art techniques in our understanding of the VIPs, which till now depended on years of observation, measurements and experiments. Efforts made by International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), an international commission dedicated to the VIPs, are narrated in the chapter. The importance of multi-disciplinary approaches and advanced technical developments in enhancing our understanding of the processes that are associated with the magma plumbing systems is highlighted.

In summary, the book undoubtedly provides an easily understandable overview of the contemporary integrated and multi-disciplinary research being done on the VIPs. I have no hesitation in recommending it to be an invaluable companion of the curious young (and old) minds who are interested in embarking research on volcanic and igneous plumbing systems.

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Comprehensive Remote Sensing, Volume 7: Atmosphere. Editor in Chief: Shunlin Liang, Volume Editor: Mitchell D. Goldberg. Elsevier, Radarweg 29, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. 2018. xxii + 545 pages. Price: not mentioned.

Earth's atmosphere comprises layers of gases and dust and plays a major role in sustaining life on the planet by creating adequate pressure allowing liquid water to exist, warming surface through greenhouse gases and balancing diurnal temperature extremes. Presence of clouds changes the radiation budget of Earth's atmosphere. Observations from space-based satellites play a key role in global monitoring of atmospheric phenomena such as cyclones, extreme rainfall events (EREs), concentration of greenhouse gases (GHGs) and other pollutants, etc. Recently, assimilation of satellite data in Numerical Weather Prediction (NWP) models has shown immense potential for improving forecasts.

This book under review updates the understanding as to how satellite-based measurements and associated remote sensing techniques provide information on the states of various atmospheric parameters. Further, the book emphasizes on the evolution of various instruments and their characteristics that are used in remote sensing of aerosols, atmospheric gases, cloud microphysical properties and vertical sounding of temperature and water vapour, etc. There are specific chapters on advances in ozone sounding in ultra violet region, infrared and microwave sounding of temperature and humidity, detecting cloud vertical structures, advanced instrumentation and techniques for detection of aerosols and trace gases. The authors discuss principles involved in remote sensing, the

challenges of measurements, calibration/validation and role of radiative transfer modeling in precise and accurate retrieval of geophysical parameters. Experts in the field of atmospheric remote sensing have contributed articles and their views represent the state-of-the-art in the field. Case studies on selected sensors, including their design, retrieval techniques for parameters and scientific applications to atmospheric studies make this book extremely valuable.

Instruments placed on satellite platforms are designed to measure the radiance from Earth and its atmosphere. Electromagnetic signal measured by satellite instruments in different spectral regions (UV, Visible) are produced by either scattered and reflected sun light or emission (infrared, microwave) from Earth with contribution from atmospheric aerosols, clouds and Earth's surface. Measurements are designed to be carried out at specific wavelengths depending upon sensitivity of atmospheric constituents of interest. That is why each instrument is designed for specific spectral window and required spectral resolving power. For example, the 313.3, 317.5, 331.1, 339.7, 360.0 and 380.0 nm wavelengths with spectral resolution of 1.0 nm were used in first global mission to produce daily maps of total column of ozone in TOMS in 1978 and similar philosophy was followed in GOME, SCIAMACHY and OMI instruments. Radiative transfer modelling is applied to retrieve the atmospheric parameter of interest. Sometimes, nonlinearity in the physics of radiative transfer and ill-posed nature of the inverse problem poses inevitable issues.

Depletion of ozone in the stratosphere has been of particular concern to the scientific community. Hyperspectral sensors such as GOME, OMI and SCIAMACHY have provided long-term records of ozone profile in the atmosphere. A dedicated chapter in this book provides description of Ozone Mapping and Profiler Suite (OMPS) for retrieval of ozone in different viewing modes. Nadir observations of total column ozone and low-vertical resolution ozone profile along with limb observation of high vertical resolution ozone profile are available from space-based sensors. The authors have emphasized the need to perform inter-calibration of sensors on polar and geostationary platforms to identify biases, improve product accuracy and