A VOLCANIC VOYAGE OF DISCOVERY

Figure 1 – Oldoinyo Lengai from the south, showing the typical steepness and radial gullying of a stratovolcano

The February 2008 issue of *Elements* was devoted to supervolcanoes. I would like to tell you about my association with a volcano that is not "super" in the sense of size but is nonetheless "superb".

I have been a lucky man, though the luck was not of my own making. In July 1960, the pilot of an aircraft flying between Johannesburg and Nairobi reported activity in the crater of a volcano on the floor of the East African rift valley lying beneath his flight path. His report gave rise to concern that the quiescent volcano might be becoming active. Not only are volcanic ash eruptions bad news for aviators but, during earlier historic eruptions of this particular volcano, the fall-out of alkali ash on the surrounding plains had caused damage to grazing land, to the distress of cattle and game animals. The volcano is Oldoinyo Lengai, a remote volcano sacred to the Maasai tribe – Oldoinyo Lengai meaning "the Mountain of God". In view of the concern, a survey and a prediction of future activity were urgently required.

So began an association with the mountain that has persisted for the best part of half a century. Mapping the unsurveyed volcano was my first assignment as a newly appointed field geologist with the Tanganyika Geological Survey. It lies just 3^{o} south of the equator, stands 2500 m above the surrounding semi-desert country and is a typically steep stratovolcano with deep radial erosion gullies (FIG. 1). Mapping showed most of the mountain to be composed mainly of phonolitic and nephelinitic pyroclastics with a few interbedded lava flows, rock types not unusual amongst the rift-valley volcanic rocks, but the contents of the summit crater proved to be something new.

Figure 4 – Barry Dawson standing on an exceptionally viscous carbonatite flow in October 1993

Figure 5 – Evening ash cloud, September 2007. Visible on the upper left-hand slopes are recent, whitened lavas that overspilled from the summit crater.

Figure 2 – The crater of Oldoinyo Lengai in 1960, showing active cones (some surrounded by fresh black ash) overlying the central lava pool, and older whitened lava flows. The crater wall is ~200 m high.

Figure 3 – Harry Pinkerton with a vane viscometer, measuring the viscosity of natrocarbonatite in a miniature hornito, September 1988

The crater itself was around 200 m deep and had steep inner walls (FIG. 2). On the floor was a central area of cones and lava pools from which issued pahoehoe- and aa-type lavas, which were black in colour upon extrusion but which rapidly turned white. As an undergraduate student in the 1950s, I had been given to understand that carbonate lavas could not exist; at high temperatures and 1 atmosphere pressure, they would simply dissociate into oxide + CO_2. This I believed till I was splashed by flying lava whilst photographing explosions from one of the lava pools. It turned out that the lavas were carbonatite, though high in sodium and potassium, and the colour change from black to white resulted from the singular composition of the lavas and their interaction with atmospheric moisture. The recognition of the unique composition of the lava, containing as it did two new alkali carbonate minerals (gregoryite and nyerereite), opened a new page in the annals of carbonatite geology.

My report to the Survey was to the effect that, as long as lavas kept flowing, an explosive eruption was unlikely. This happy state of affairs lasted till August 1966 when the volcano went into a phase of violent ash eruption, the first since 1940. In the interim years I had lived in Canada and Scotland but, fortuitously, was in Tanzania on other field work. With the help of colleagues from the Survey, I was able to visit the volcano. Ash dispersal by a strong wind permitted an ascent of the mountain on the windward side and, seen from the crater rim, it was apparent that a new ash cone had filled in much of the earlier deep crater. Natrite-cemented lapilli gathered on the rim proved to very unusual in containing, besides the expected nepheline and garnet, corroded wollastonite and clinopyroxene that were partially replaced by combeite ($Na_2Ca_2Si_3O_9$) and melilite, respectively, thus indicating the presence of, and interaction between, silicate and carbonate magmas within the conduit.

Following collapse of the ash cone and formation of a deep pit crater at the end of the explosive activity in July 1967, the volcano became dormant, and during a visit in 1981, there was only an occasional rumbling sound at depth within the crater. The volcano remained dormant till 1983 when lava extrusion recommenced in the pit crater. By 1988 it had filled with lavas and become accessible once more, enabling direct temperature and viscosity measurements of natrocarbonatite (FIG. 3). I was back yet again in 1993 (FIG. 4) when atypically voluminous and crystal-rich flows were extruded. The presence of globules of nephelinitic liquid within the unusually viscous natrocarbonatite flows (transport of the dense silicate globules resulting from the atypically high viscosity of the flows) provided further corrobative evidence for two coexisting magmas at the volcano.

Lava flows from a series of transient lava pools and hornitos then continued to infill the crater till, in 1999, the crater rim was overtopped and natrocarbonatite flowed down the outer slopes at several points. This phase of lava extrusion and overspill continued till early September 2007, when another phase of violent ash eruption began (Fig. 5) and which is still going on (March 2008). Again fortuitously, I had arranged with Roger Mitchell (Lakehead University, Ontario) to be looking at the monogenetic crater field to the east of the volcano. We were easily diverted to the western foot of the volcano to sample the new lapilli that rained down on us. The lapilli have proved to be similar in some ways to those from the 1966 eruption, but their matrix is phosphate rich, as opposed to carbonate rich, and the lapilli matrix, lacking clinopyroxene, is neither nephelinite nor melilitite. For these latest results, see *Mineralogical Magazine* 71: 483-492, 2007.

Yes, I have been lucky. My association with Oldoinyo Lengai has been a continuing voyage of discovery, ranging from the initial discovery of natrocarbonatite in 1960 to the latest clinopyroxene-free material in the 2007 lapilli that will have the IUGS Subcommission on the Systematics of Igneous Rocks scratching its collective head for a suitable name. I have been privileged to see the volcano in all its moods, from quiet flowing of lavas that have the viscosity of olive oil, to the violent ash eruptions of 1966 and 2007. But above all, I was fortunate to have been in northern Tanganyika (as it then was) in "the old days," when the approach to my volcano was across trackless savannah and the voice of the lion was still heard in the night. These days, a dirt road runs past Oldoinyo Lengai en route to Loliondo on the Kenya border, and leads to the settlement of Engare Sero and to the tourist camps near Lake Natron. With the boom in geotourism and the better communications and facilities, the number of people now climbing Oldoinyo Lengai in a single month probably surpasses the total of all those who toiled to the summit in the first sixty years of the last century. Even so, the obliteration of the western "tourist" route by the 2007–2008 ash eruption reminds us that the more approachable Oldoinyo Lengai is still a formidable mountain, not to be challenged lightly. But has it any further geological treasures to yield up? I hope so. As the Roman geographer Pliny said, "*Ex Africa semper aliquid novi* – There is always something new out of Africa."

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IMPACT FACTORS IN THE 21st CENTURY

(Cont'd from page 137)

HOW DO YOU IMPROVE A JOURNAL'S IMPACT FACTOR?

Publish more long papers and reviews. Publish papers describing new or improved techniques; these are sometimes, but not always, big hitters. Publish papers with long reference lists. Make the content available to more people by making it available to all, free of charge. Publish thematic sets of papers in more popular areas. Increase the size of the audience through increased sales (or through inclusion of your journal in e-journal aggregates).

ALTERNATIVES

A possible alternative to the impact factor has been suggested in the UK. The department of the former Chancellor of the Exchequer, Gordon Brown, has suggested that a researcher's quality of output should be based on his/her success at obtaining research funding.

Perhaps of more benefit, to publishers at least, would be the knowledge of readership. A new industry-standard method of counting downloads of journal content (Counter 2.0) has been in operation since early 2006. If, as stated above, the goal is education, then can we not say that the number of times an article is downloaded is at least as valid, and probably more so, than the number of citations? There is not necessarily any correlation between downloads and citations. Some heavily downloaded papers do not turn out to be as highly cited as might be expected if there were a correlation between the two.

A relatively recent publishing phenomenon has been the clamour for access by the public to the results of research carried out by publicly funded researchers. If this comes to pass, then does it not strengthen the case for using a download count rather than a citation count? A paper that has value to the public must serve the goal of education as much as one serving the need of the smaller academic-only community. Researchers in Los Alamos, and elsewhere, have been working on alternative metrics which will take into account usage as well as citations. Early signs, however, suggest that for subject areas with large numbers of devotees, the impact factor and usage factor correlate (Bollen and Van de Sompel 2008).

The '*h*-index', suggested by Jorge E. Hirsch as a tool for determining theoretical physicists' relative quality, purports to quantify the scientific productivity and the so-called scientific impact of a scientist. It is based on the scientist's most cited papers and the number of citations of them. A scholar with an index of h has published h papers each of which has been cited at least h times. The same index can be applied to groups of scientists, e.g. in a department or university or country. The *h*-factor removes emphasis from a large number of citations for a small number of papers, and considers a larger number of papers.

The '*g*-index' is similar. Given a set of articles ranked in decreasing order of the number of citations that they received, the *g*-index is the (unique) largest number such that the top g articles received (together) at least g^2 citations (definition from Wikipedia).

PROBLEMS WITH THE IMPACT FACTOR

None of the major citation-based metrics places importance on the context of the citation. Is the citation included to give background information, or are its conclusions dealt with in depth? Is the citation made in a negative context, as a correction, or to fraudulent work?

And what of the number of authors? The simplest way to increase your *h*-factor, or any other factor for that matter, is to have yourself included as a co-author on as many papers as possible, irrespective of the amount of work you've done on the paper.

DATA MINING

A recent paper by Petford and Adams (2008) describes a study on citation data obtained from the Thomson ISI® science citation database. There is much of interest: citation data have been normalized (Rebased Impact [RBI] index) in different subject areas to a world average for any given year. Of great interest, though, is the fact that 21.4% of all UK papers in the geosciences (*sensu lato*) are uncited (of almost 23,000 papers published from 1995 to 2004). A further 42% of journal articles are cited, but are below the world average. Note that similar performance is noted in physics and chemistry. Thus, although the UK average RBI for geoscience papers is 1.33, above the world average, two-thirds of the material is uncited or cited less than the average.

CONCLUSION

This debate continues to rumble on, and we hear about how key groups, e.g. those responsible for the Research Assessment Exercise in the UK, are moving even more towards metrics systems of evaluating impact and quality. Hopefully, new systems will continue to become available – ones which consider more factors than just citations, e.g. downloads/usage. This, one feels, would level the playing field for all concerned.

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REFERENCES

Bollen J, Van de Sompel H. (2008) Usage impact factor: The effects of sample characteristics on usage-based impact metrics. Journal of the American Society for Information Science and Technology 59: 136-149

Petford N, Adams J (2008) Goalposts on the move. Geoscientist 18(2): 18-21