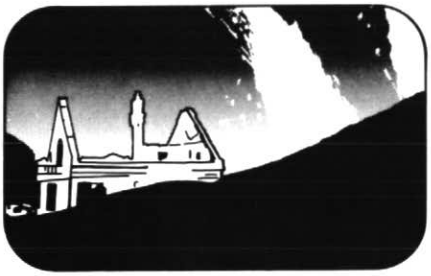
Articles



Volcanoes in Our Lives

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Note

Charles Stuart Ney, long term member of GAC, died May 24th, 1975. This article is the text of the talk that he delivered to a meeting of the Cordilleran Section of GAC in February, 1974. Mr. Ney had long been active in B.C. geology, working for Pioneer Gold Mines, Polaris Taku Mining and Kennco Exploration. In 1973 he moved to Quintana Minerals Corp. as vice president in charge of geological exploration in Canada, Alaska and northwestern United States. He was made an honorary member of the Cordilleran Section of GAC in 1973.

Introduction

Most of us who are at all involved in Earth Science regard volcanism as perhaps the most exciting of all the processes of geology. My look at volcanoes and volcanism will be the impressions of a layman in this field. I look upon the subject from the four aspects of Social, Economic, Historical, and Aesthetic.

Social Aspects

People like to live on and around volcanoes. It may be the extra fertile soil in volcanic areas, it may be simply the love of homeland regardless of its drawbacks, or it may be the excitement of coexisting with a wild force of Nature. People return to scenes of disaster, as they returned to St. Pierre after its destruction by Mount Pelée in 1902; the Hawaiians revise their maps and reroute their roads as lavas pour out willy-nilly; and the Icelanders shovel fallen tephra from their homes and streets as though it were only a snowfall. In the circle of fire around the Pacific, and in many other parts of the world, volcanoes are in continuous confrontation with millions of people. There is obviously a need for study, understanding and surveillance of volcanoes, that will be continually more pressing, as we place higher values on human safety.

The pursuit of volcanology has demanded from its disciples a high degree of dedication, adventurism, and courage. Our own group from Canada, who recently brought us an exciting account of their visit to the eruption of Kirkjufell in Iceland, were no exception, nor were the underwater geologists who obtained the fantastic movies of the formation of pillow lavas in Hawaii.

In his beautiful book on volcano Surtsey, Sigurdur Thorarinsson describes a landing on the island just 100 days after it had emerged from the sea. The party of seven included two ladies. No sooner had they landed than Surtur (giant of Norse Mythology) set upon them with a volley of bombs. Red hot lava fragments up to a yard in diameter began falling all around them. The group had to learn fast not to panic and run, but to look up into the sky, figure out the bomb's trajectories, and then dodge adroitly at the last instant.

Another example that sounds a little humorous but was none the less sincere, was that of two Russian scientists Popkov and Ivanov who were working in Kamchatka in 1938. They rode on a moving lava flow for about an hour travelling two kilometres. Although equipped with asbestos soled shoes, they soon became hot footed. It was here that their early training in ballet proved valuable. They were able to hop on one foot while waving the other around to cool off, and simultaneously reading pyrometers, analyzing gasses, and taking notes.

Any serious discussion of the exploits of volcanologists brings to mind the work of Frank Perrett on Mt. Pelée during the eruption of 1930. Perrett became a volcanologist through ill health. In his early years he worked as an inventor of electrical apparatus with Thomas Edison. The cold damp air of New York finally got to him and he moved to Naples, where he embarked on a career in volcanology. On hearing of the 1930 eruption of Mt. Pelée on the Island of Martinique he made haste to get there to observe the Nuée Ardente that Lacroix had described in 1902. He stayed for months at a time in a frame shack high on the slopes of Mt. Pelée where he could observe at close hand how the Mountain top would swell with stickly lava then burst out with death-dealing nuée ardentes. These silent glowing avalanches with their noxious dust clouds continually threatened his life in this frail mountain abode.

Perrett's science was sincerely dedicated to the prediction of eruptions and the saving of people's lives. At Mt. Pelée in 1932, people remembered the disaster of 1902 and fled their homes in St. Pierre. After a brief study, Perrett assured the inhabitants that it was safe to stay in St. Pierre, and he settled there with them, turning down an invitation to live at a sumptuous country estate. As an inventor, he saw the need for ground microphones and seismographs in volcano warning systems. At Stromboli he found one night that by placing his teeth against an iron bedstead he could pick up subaudible vibrations of impending eruption. While waiting for a ship at San Juan to take him to Mt. Pelée he hastily contrived a microphone out of materials at hand. This must have required a little ingenuity in 1932. Nowadays one would only have to go to the nearest Radio Shack or look it up in the Heathkit Catalogue. How he must roll in his grave with envy at the battery of seismographs and tiltmeters now in use at the Volcano Observatory in Hawaii.

No less dedicated to saving lives were a group of Japanese geologists at Asama in 1958. On a sunny weekend the summit of this active volcano was typically swarming with hikers and sightseers. The geologists recognized that they had to predict two classes of eruption; a major and infrequent disaster that would endanger large areas and require elaborate warnings; and quite small bursts of activity that could take a serious toll of lives from visitors on the summit. When in the summer of 1958 a crescendo of earthquake activity foretold an eruption, the geologists regretfully advised the authorities that hikers should be kept off the mountain. The eruption came, but it was about three weeks later than they had predicted. Many lives were saved, but in an epilogue to their paper, the geologists were genuinely apologetic that they had been out in their prediction and unnecessarily denied the public three weeks of hiking pleasure on the mountain in the sunny season. They concluded that if only they had a few more seismographs they could have done a lot better.

Economic Aspects

The economic aspects of volcanism include both mineral resources and energy resources. I recall that Lindgren, 30 years ago, described volcanic settings for such mineral districts as Creede, Cripple Creek, and Braden, but the association was regarded more as one of structural coincidence rather than genetic process. Only a few deposits of sulphur and mercury were described as having any direct association. The apparent volcanic setting of Braden appealed to prospectors, and this association was regarded as an exploration guide, despite the fact that the famous Braden pipe was later shown to be mostly post-mineral.

A paper of a few years back on the Boulder Batholith in Montana showed that intrusion and mineralization were preceeded by the effusion of a great pile of volcanic rocks. The batholith, containing one of the world's greatest mineral districts, apparently formed beneath a volcanic edifice of its own making. Although prospectors recognize an association in space and time between the environment of porphyry mineralization and volcanic activity, yet there is still a gap in associating sites of mineral desposition with the surface structure of volcanoes. One may note that in all the great Cascade volcanoes of Western U.S. the only mineral deposit known is one of sulphur on Mt. Adams.

Recognition of the relations between stratabound pyritic deposits and volcanic environments came about gradually up to about 1960, then the idea cascaded rapidly. Valuable new exploration guides were evolved, and now there is a tendency to call deposits volcanigenic even when there are no volcanic rocks around.

Old descriptions of Noranda in my notes indicate that rhyolite is a favourable rock while andesite is unfavourable. It would seem but a small step to conclude that one rock was pre-ore while the other was post-ore, but descriptions of mineral deposits 20 years ago were bound to the ideas that ore must replace older rocks along structures. Not that structures were unimportant.

Mine geologists who had to face up to the daily problem of keeping a hungry mill supplied with ore, had to be entirely fluent with structures of all kinds, and it was these mine geologists who painstakingly observed and assembled the data base on which generalists could come along and generalize.

However one of the papers in a C.I.M.M. Symposium on massive sulphides in 1960, emphasized that relations of ore to structure were not necessarily facts of origin. This was by Stanton, who recognized ores as facies of rock formations. His expression "the environment of ore" has spread rapidly through economic geology to deposits of all types, and has proven a most useful concept in classification and search for ore.

Geologists at Britannia relate that in a 1951 paper Ms. Dolar Mantuani suggested that Britannia was a volcanigenic deposit.

With regard to energy resources, Geothermal Power seems to have tremendous appeal to a public who are impressed by the awesome power of volcanoes but not aware of their limitations.

Anyone should be impressed by the continuous loss of heat from the House of Everlasting Fire at Kilauea Crater in Hawaii, and from the frequent fire fountains and lava flows as they radiate to the sky or quench themselves in the sea. Volcanoes would appear to be the answer to the energy crisis. Suppose we could devise plants that would tap off the 1200° lava and use the heat to generate electricity. Then we could make hydrogen and ship this pollution-free fuel to mainland America where the people are freezing in the dark.

Some amazing rates of lava production have been recorded at Kilauea - as much as two million cubic metres per hour. The current Mauna Ulu eruption described in May 1971 *Geotimes* produced four million cubic metres in a 21 hour episode. But estimates for Mauna Loa over a 100 year period indicate a lava production of just 30 million cubic metres per year. For the growth of the whole Hawaiian chain it may be as much as several hundred million cubic metres per year.

If we calculate the power that could be derived from say 100 million cubic metres of lava per year cooled through 1000° at 20 per cent efficiency, we find that the amount is a paltry 1.5 million kilowatts, hardly enough for Vancouver, and short by three orders of magnitude of doing much for U.S. requirements.

All this was pointed out by King Hubbert several years ago. It shows, not how small is the energy of volcanoes, but how gargantuan is the energy appetite of America, which relies on solar energy husbanded by nature for the last 500 million years.

Historical

As a third aspect of volcanoes, I would venture to speculate on their importance through geologic history in prescribing environments for the evolution of life. Nobel Prize winner S. E. Luria points out that the existing biota on earth, including humans, represents only one outcome out of an enormous number of possibilities. Each step in evolution is an outcome characterized by a precise fitness between organisms and environment.

Now past environments must certainly have been set up, at least in part, by volcanoes. Howel Williams emphasized their overall importance in supplying the atmosphere with CO_2 and the ocean with water. Traces of other gases, and a continual supply of elements to soils and water must make subtle contributions to the environment; and particulate matter from volcanoes no doubt modified environments by changing climates.

Discussions on climate modification by volcanoes end with consideration of the effects of historical eruptions such as Agung, Krakatoa and Katmai. There is some agreement on the idea that Krakatoa did bring about a period of lower temperatures, and also that the Little Ice Age of the last 800 years may have resulted from Volcanism.

The eruption of Katmai in 1912 was close to home. I am told on good authority of my mother that ash was wafted over Vancouver, and that corrosive gases destroyed delicate fabrics hung out on lines. First hand accounts from Kodiak, 100 miles from the volcanoe, tell of an eruption cloud so dense that a lantern could not be seen when held at arm's length. Even allowing for a combination of a very long arm and a very poor lantern, this represents a lot of dust particles (several hundred per cubic centimeter) yet people continued to breathe and live.

Now the record of ash flow tuffs in western U.S. during the period 20 - 28 m.y. ago suggests that volumes of ash 10 to 100 times that of Katmai must have been erupted in single episodes. Cooling units of 100 to over 1000 cubic miles have been described compared to Katmai's five cubic miles. Surely such eruptions would have profound effects on environments for prolonged periods. Those who would study past environments should consider the effects of such eruptions.

The direct traumatic effect of great eruptions on evolving organisms may well be considerable. The eruption of Coseguina in Nicaragua, January 2, 1835 was one of the worst disasters in history, although no lives were lost. The event was described by one Colonel Juan Gelindo and reported in my local library book. With no recorded premonitory symptoms the clear morning sky of Nicaragua rapidly blackened with an expanding dust cloud. By afternoon, prolonged earthquakes were felt, phosphorescent ash fell from the cloud, and near total blackness, except for flashes of lightning, prevailed for the next two days. Throughout Central America, people and beasts were terrified, and it was proclaimed that the day of Judgement had arrived. In the village of Alancho, it is reported that 300 couples who were living happily but rather loosely, felt that in the face of impending doom, they should become legally united. So they were, hastily but securely, married in a mass ceremony conducted in thundering blackness. No sooner had this drastic action been taken than the ash stopped falling, moon and stars appeared, and the thunder was swallowed in silence, and to this day Coseguina has been at rest.

This event may or may not have cut a little niche in the pattern of evolution, but I cite it as a suggestion that environmental stress may well bring about changes in surviving populations.

Aesthetic

Any discussion of the Aesthetic aspects of volcanoes must be a personal view, because beauty is in the eye of the beholder. Perrett was ecstatic about the beauty of the fearsome nuée ardente of Mt. Pelée. Thorarinsson extolled the beauty of the violent interactions between lava and the sea at Surtsey. Geologists not so fortunate as to be on deck when eruptions occur, find beauty in reconstructing past events from the record of the rocks. Pahoehoe is a substance of great beauty when viewed freshly cooled through a hand lens. The interests of the public vary greatly through birds, flowers, and gemstones, but nearly always there is a broad area of overlap in the realm of scenery.

One of the fringe benefits of a jet flight from San Francisco to Vancouver, provided one has a window seat and a clear day, is a perspective of some of the world's most beautiful volcanoes. A few minutes out of the Bay we see the ragged Sutter Buttes protruding anomalously out of California's Great Valley. Then at the north end of the Sierra Navadas is Mt. Lassen, scarred

Figure 1
Mount Garibaldi, a Pelean volcanoe erupted during the waning stages of the last Cordilleran ice sheet. Photo courtesy of Austin Post.

and misshapen from eruptions of 1915. Next is Mt. Shasta with its offspring cone of Shastina beside it. The volcanic wonderland of Oregon unfolds with volcanoes too numerous to count, dominated by the ruins of Mt. Mazama forming a setting for the jewel of Crater Lake. Next we see Mr. Hood, old Mt. Adams, youthful Mt. St. Helens, and then Mt. Rainier, sometimes all in one view. Mt. Baker is something of an anticlimax as we approach Vancouver, and with luck we can see our own Mt. Garibaldi (Fig. 1).

The succession of volcanoes does not end there. Although smaller in stature, our B.C. volcanoes are no less interesting (Fig. 2). Going north from the complex Garibaldi area, we find volcanism at Mt. Fee, then at Mt. Plinth, where the Bridge River pumice fall of 2400 years ago was erupted. Then there is the little known Mt. Silverthrone, and after a considerable gap the little Tseax Cinder Cone with its impressive lava flow. Finally there is the well known Mt. Edziza with many small expressions of youthful volcanism around it.

Most of the U.S. volcanoes mentioned are National Parks, or Forests, or areas set aside in some way for study, recreation, and enjoyment. Basically they provide extensive areas at the alpine meadow elevation that appeal to all nature lovers. But a great many people are turned on by the scenery of volcanic terrains. They feel the vibes of the restless, anomalous and transient topography whether or not they know any geology.

Figure 2
Postglacial Clinker Peak lava flow (right) and lava-dammed Garibaldi Lake, 40 miles north of Vancouver, B.C. Photo courtesy of Austin Post.

We should therefore consider volcanoes as more than convenient sites for people to roam around and view plants and animals. Potentially they are areas of interaction between Geoscience and general public. They present valuable opportunities for communicating with people who now have the time and money to be genuinely interested in earth processes but have not had the opportunity to take geology at University. There are millions of such people.

Efforts have been made in areas such as Mt. Rainier and Kilauea to provide such communication to the public. The rangers in Kilauea go out of their way to let the public experience volcanism.

At Crater Lake examples of what happened to Mt. Mazama 6000 years ago are very striking. Here the writings of Howel Williams are absolutely outstanding in the way they present evidence and interpretation of geologic events. Almost any thinking tourist can pick up the vibes here, and realize that this delightfully scenic parkland was prepared by nature in episodes of fire, destruction and violence. The lake was discovered by prospectors in 1853 but they found no gold and left. What they did find was a jewel infinitely more valuable to people's spirits than many a vault of gold.

Our own Garibaldi area has been well studied and described by Mathews but to my knowledge the fascinating story of the battle between fire and ice has never been conveyed to an interested public. There are again a multitude of signs discussing the plants but very few on geology. Of about 20,000 visitors a year to this place I am sure only half a dozen pick up any geology.

Roads and people are now getting in to Mt. Plinth, 100 miles north of Vancouver. Mt. Silverthrone is only a few hours away. Little Tseax is already becoming ravaged by industry and the hundreds of people that pass by don't have a chance to learn anything about it. Fortunately Mt. Edziza is in good hands, and hopefully someone will write its story in a way that we can all enjoy.

There are then the volcanoes of earlier epochs that have interesting stories to be told. There is Coquihalla Mountain near Hope B.C., and Mt. Begbie of the late Miocene right on the highway to Williams Lake. Several volcanic sedimentary basins of the early Tertiary are exceedingly interesting. Some of these have been described in technical reports - but again there is nothing available in a language that the public can understand.

Conclusions

To conclude, I would suggest that the social aspects of volcanism present a growing and challenging field of investigation. We could effectively use many more seismographs, and tiltmeters, with enthusiastic geologists to interpret them, through Central America, the Aleutian Islands, the Cascades of U.S. and also in British Columbia, where some of our volcanoes may be merely resting.

Volcanoes all through the past have generated the geological environments for the concentration of many of our mineral resources. Prospectors have much to gain by exposing themselves to studies of volcanoes, future prospecting for hidden targets will have to evaluate the chances of finding ore where only the surface structures of volcanoes are in evidence.

The direct potential of Geothermal Energy of volcanism on a sustained yield basis, falls far short of world needs, but for limited needs in local situations, it is a shame to see it wasted.

Regarding the effects of volcanism on organic evolution, I think there is much to be done by extrapolating, on the basis of ancient volcanic formations, the environmental effects of huge eruptions. We humans evolved through a succession of selections based on fitness to an environment to which volcanism contributed in many ways. We can say that we owe our very existence in our present form to the presence of volcanoes through earth's history.

The aesthetic attractions of volcanoes and volcanism toward intelligent but poorly informed groups of society, present an opportunity that earth scientists should not miss for broadening the interest in their science. We are already behind in keeping touch with the public on our B.C. volcanoes, and we should take a little time away from finding orebodies and writing papers to converse with the public.

Volcanoes have at times been rude and rough to the living things of the world, yet in the long run they have been essential, useful, and friendly. We have societies such as "Friends of the Pleistocene", etc. We need a society called "Friends of Volcanoes" and all of us in gratitude, should become associates if not contributing members of such a society.

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