ASH FALL

Newsletter of the Volcanology and Igneous Petrology Division
Geological Association of Canada

#43 MAY 1977

Message from the Executive

After being very late getting out the last Ashfall, we are attempting to get on track with the regular spring edition coming out more or less on time. We urge you all to turn up at the annual meeting is at 16:00 Monday May 19 in Capital Hall room 1B. We are aware this is not a convenient time as it is in conflict with the first poster session. The executive will make every effort to streamline the meeting so you can return to the posters. Apart from routine passage of accounts, we have a few items of business that need your attention. The Division is sponsoring a special session in Quebec next year, but we need ideas, volunteers for upcoming annual meetings. Although a new slate of officers took over last year, the Councillor East is up for re-election and the post of Councillor Research was left vacant last year when Kelly Russell stepped up to the Chair. We also have the happy task of presenting two Gelinas medals this year. The medalists are PhD (Gold) Mark Shore, Ottawa University "Cooling and crystallization of komatiite flows" A.D. Fowler Director, and MSc (Silver) Martin Heiligmann, Université du Montréal "Soil gases at Galeras volcano, Colombia, and their utility in eruption prediction" J. Stix Director.

We should also pay some attention to future projects for the division beyond sponsoring special sessions and field trips. A couple of suggestions from the Vice Chair are as follows. One group of students that the Division has not paid much attention to in the past is the undergraduates. We could promote Volcanology and Igneous Petrology by awarding a prize for the best BSc Honours thesis. This would cast a wider net than the present Gelinas awards. I think we have to realise that not many students do graduate work any more in VIP. It would probably be feasible to have an April 15th submission deadline and select a winner by early May. I do not know if it would be feasible for the VIP Division to promote a regional visiting speaker program. Within a region, travel costs can be kept relatively low and host organisations can be expected to pay food and accommodations. It might be possible to get some money from the "Howard Street Robinson Fund", which supports Precambrian and Mineral Deposits Geology. Obviously potential adoption of either or both of these suggestions may entail a review of our present fee structure.

Musings: Ever wonder who dreams up the code words for servers in e-mail addresses? Note the University of Toronto is divided into a quartz and a zircon faction. Was this crystal fractionation? Is there a deep meaning to each address? I see the annual meeting being chaired by Kelly in his Perseus guise, peering into a highly polished shield looking for a Medusa in the membership. Is Georgia a card or a pool shark? Enough.

IGNEOUS ROCKS AND THE OCEAN DRILLING PROGRAM

Two recent and several upcoming legs of the Ocean Drilling Program (ODP) may be of interest to readers of Ashfall.

Leg 168 investigated three hydrothermal regimes located on the sediment-covered eastern flank of the Juan de Fuca Ridge off BC.

Leg 169 drilled actively forming massive sulphides in the Middle Valley of the Juan de Fuca Ridge and the Escanaba Trough on the Gorda Ridge. Further information on the findings of these legs are available from the Canada ODP office,
email: odp@quartz.geology.utoronto.ca;
web site: http://www.geology.utoronto.ca/ODP

Several future legs have igneous objectives:

Leg 173 (Apr-June 1997) off the western Iberia margin will sample basement to characterise the transition from oceanic to continental crust, including the role of syn-rift magmatism.

Leg 176 (Oct-Dec 1997) will deepen Hole 735B in order to study the temporal and spatial variability of the internal tectonic fabric of the lower ocean crust at a very slow spreading ocean ridge

Leg 180 (June-July 1998), in the Woodlark Basin off Papua New Guinea, will investigate the processes of active continental rifting immediately prior to seafloor spreading

Leg 183 (Dec. 1998-Jan 1999) will sample igneous basement to depths of 200 m in several parts of the Kerguelen Plateau - Broken Ridge Large Igneous Province: an area where a voluminous magma flux was emplaced over a relatively short time period.

Recent Publications

Fire and mud: Eruptions and Lahars of Mount Pinatubo, Philippines. 1996 eds. C. Newhall and R. Punongbayan (Philippine Institute of Volcanology and Seismology and University of Washington Press).

Mauna Loa Revealed. 1995 eds. M. Rhodes and J. Lockwood (American Geophysical Union).

Monitoring and Mitigation of Volcanic Hazards. 1996
eds. R. Tilling and R. Scarpa (Springer-Verlag, Heidelberg).

Recent Eruptions:

Things seem pretty quiet, with a number of volcanoes steaming happily away, the following includes some recent activity and a few I missed in the last survey.

Okmok Volcano

Okmok volcano began erupting in mid-February, 1997. Okmok is on Umnak Island, in the eastern Aleutian Islands, about 75 miles west-southwest of Dutch Harbor. The first sign of heightened activity was a "hot spot" observed by AVO scientists, on satellite images taken at 5:00 and 10:30 am AST on February 13, 1997.
Later on February 13, observers at the former Fort Glenn military base, 10 miles east of the volcano, reported seeing a dark ash plume at about 10 am AST rise above the caldera rim to an altitude of about 5,000 feet ASL where prevailing winds carried it to the southwest. Later reports from on-site observers suggest that the eruption began at least a few days before February 13. Okmok volcano is a 6-mile-wide caldera that occupies most of the eastern end of Umnak Island that has had several eruptions in historic time. Historic eruptions typically consist of ash emissions occasionally to over 30,000 feet but generally to much lower altitudes; lava flows crossed the caldera floor in 1945 and 1958. The last eruption occurred November 1986 through February 1988 and was characterised by intermittent ash emission.

The nearest settlements are Nikolski, population about 35, about 45 miles west of the volcano, and a small number of people at the abandoned Fort Glenn military base 10 miles east of. the volcano. Okmok volcano is a 6-mile-wide caldera that occupies most of the eastern end of Umnak Island that has had several eruptions in historic time. Historic eruptions typically consist of ash emissions occasionally to over 30,000 feet but generally to much lower altitudes; lava flows crossed the caldera floor in 1945 and 1958. The last eruption occurred November 1986 through February 1988 and was characterised by intermittent ash emission.

Pavlof

Current Status (Friday, April 4, 1997).-- (From the 4/4 AVO update) Seismicity at Pavlof has returned to a near-background level after fourteen weeks of eruptive quiescence. No thermal anomalies are present on satellite images. Although the likelihood of renewed activity is still above normal, the immediate hazard level is low. Pavlof will be removed from the itemised report if quiescence persists for another week, though AVO will continue to monitor the volcano closely.
Previous Status (Sunday, December 29): -- Pavlof erupted in it's strongest eruption of the current episode in the early morning of December 27th, ending about eleven days of quiet. Starting on December 26th, small bursts of tremor occurred every few minutes. By about midnight tremor was continuous and the intensity of seismicity was increasing steadily. Eruption intensity peaked in the early morning and then slowly dropped back to a level similar to that during the continuous Strombolian eruption of November. Seismicity at Pavlof has since returned to low, inter-eruption, levels. Local observers report that there is no eruption in progress. AVO returned to Color Code YELLOW on Sunday morning.

RAPID RESPONSE TO SUBMARINE ACTIVITY AT LOIHI VOLCANO, HAWAII

Authors: The 1996 Loihi Science Team
Loihi seamount, sometimes known as the "youngest volcano" in the Hawaiian chain, is an undersea mountain rising some 3500 meters above the floor of the Pacific Ocean. Both Loihi and Kilauea volcanoes sit on the flank Mauna Loa volcano, an older, larger, and still active volcano on the Big Island of Hawaii. Loihi sits submerged in the Pacific off of the south-eastern coast of the Big Island of Hawaii. Although hidden beneath the waves, Loihi is nevertheless taller than Mt. St. Helens was prior to the catastrophic volcanism there in 1980.

Before to the late 1970's, Loihi was not known to be an active volcano. It was thought to be a fairly common old seamount volcano of the type that surrounds the Hawaiian islands. These latter volcanoes are similar in age (80-100 million years old) to the sea floor upon which the Big Island of Hawaii sits. This sea floor was itself created some 6000 km away on the undersea volcanic mountain chain known as the East Pacific Rise and then slowly moved north-westward to the present location of the Hawaiian Hotspot.

In 1970, our ideas about the seamount changed drastically following an expedition went to Loihi to study an earthquake swarm (intense, repeated seismic activity) that had just occurred. It was revealed that Loihi was a young, active volcano, rather than an old dead seamount from a bygone aeon, as conventional wisdom of the time had suggested. We now know that Loihi shares the Hawaiian hot spot with its larger active siblings Mauna Loa and Kilauea. This past August, Loihi rumbled to life again with a vengeance, as described below.

Introduction

During July and early August, 1996, the largest swarm of earthquakes ever observed at any Hawaiian volcano occurred at Loihi Seamount. In response to this event, an initial cruise was dispatched to Loihi in early August (Rapid Response Cruise: RRC), and two previously planned cruises sailed in September and October (LONO Cruises) on the R/V Kaimikai-O-Kanaloa (K-O-K). Calm weather and a newly refurbished ship combined to provide excellent conditions for documenting the volcanic, plume, vent, and biological activity associated with this swarm. These cruises conducted a total of 15 PISCES V submersible dives, 41 water sampling operations, and 455 km of SeaBeam surveys, and deployed 40 sonobuoys and one ocean bottom seismometer (OBS). The most obvious result of the activity was the formation of a large summit pit crater similar to those observed at Kilauea. Greatly expanded hydrothermal activity was also observed resulting in the formation of intense hydrothermal plumes in the ocean surrounding the summit.

Earthquakes and Noise

Between July 16 and August 9, 1996, over 4000 earthquakes from Loihi were detected by the U.S.G.S. Hawaiian Volcano Observatory (HVO). The initial phase of activity, consisting of 72 located earthquakes, continued for two days. After 30 hours of quiescence, activity resumed and continued at a higher rate, averaging over 88 events per day for the next 10 days before slowing.

Preliminary locations calculated using the HVO seismic network data place the majority of events between depths of 10 and 14 km shallowing seaward. P-wave arrivals at an OBS deployed on Loihi summit during the third week of the swarm arrive about two seconds early, suggesting that the velocity model used for the island of Hawaii is inappropriate beneath Loihi, and that initial locations are suspect. Using HVO's preferred velocity model under Hawaii and considerably lower shallow velocities under Loihi, reasonable hypocentral locations are obtained near 8 km depth. Despite the obvious topographic modifications of the summit, few shallow earthquakes (between 0 and 5 km) were located.

Structure

SeaBeam surveys documented the bathymetric changes at Loihi summit corresponding to the seismic swarm. Pele's Vents, previously the prime locus of hydrothermal activity at a depth of 980m, has collapsed forming a pit crater (Pele's Pit) approximately 600 m in diameter with its bottom 300 m below the previous surface. Portions of the West Pit rim and areas to the north have faulted down several meters towards the summit center, bisecting Pisces Peak.

Hydrothermal plumes

Intense hydrothermal plumes resulting from the seismic event were studied using hydrocasts (vertical water sampling at a single site) and tow-yos (sampling by an instrument package raised and lowered behind a moving ship). Temperature anomalies of 0.5°C were common during the RRC in the water column around the summit at depths of 1050-1250m, with anomalies of 0.1°C at distances >8 km [see Fig 4 below]. In contrast, mid-ocean ridge plumes typically have maximum anomalies of 0.02-0.1°C, although event plume anomalies of up to 0.3°C have been observed (e.g., Baker et al. 1987). One surprise was the observation of a very intense plume at 1600-1800 m depth at a “background” station 50 km NNE of Loihi. A marked decrease in pH (0.2 units) and a remarkable 3He enrichment (150%) were measured, suggesting an injection of magmatic gases to the water column during a large short-lived, but rapidly cooled, volcanic episode well below the summit of Loihi during the early stages of the seismic event. Sharp vertical temperature and chemical gradients measured by RRC hydrocasts showed that hydrothermal fluids were accumulating in the bottoms of the pit craters. Anomalies of up to 3.5°C and 0.65 psu salinity were measured. Tracers of hydrothermal and volcanic emission in the pits were greatly enriched with respect to ambient sea water: Fe = 45,000x (45 μM), Mn = 29,000x (5.7 μM), CH4 = 560x (280 nM), H2 = 100x (20 nM), and TCO2 = 7x (17 mM). The pH of this water was 5.6, and there was no detectable sulfide smell.

LONO hydrocasts showed that temperature anomalies within Pele’s Pit had decreased to 0.6°C after the RRC. Nevertheless, a hydrocast 1.2 km west of the summit detected numerous plumes with anomalies up to 0.10°C between 1050 and 1330 m, the largest coming from the intense venting near the bottom of Pele's Pit. The hydrothermal plume was detected >12 km west of the summit.

Hydrothermal vents

Vent fields with temperatures of up to 77°C were discovered during the LONO cruises, one near the bottom and two on the north wall of Pele's Pit, two on the south rift, and one west of the summit. Venting was generally diffuse, exiting through nontronite coated talus, although 13 m wide fissures vented large volumes of water in the south rift vent area. Rocks bearing several high temperature sulfide minerals were collected, suggesting that vent waters had been very hot (at least 250°C) during formation of these deposits. This apparent decrease in temperature with time will be verified by temperature recorders and samplers emplaced for yearlong sampling of vent fluids.

Vent fluid samples were collected for analysis from seven vents. Gas content of the fluids was >52 mmole/kg, or 17 times the background sea water value. Carbon dioxide continues to be the dominant vent fluid gas, but its ratio to dissolved silica and vent temperature (heat) has decreased dramatically during the last decade: dissolved CO_2/heat ratios decreased by about 30% between 1987 and 1992 (Sedwick et al., 1994). The LONO CO_2/heat ratios continued this trend, decreasing by over 90% relative to the values measured in 19871992. These decreases have been ascribed to progressive degassing from a magmatic intrusion. The much lower CO_2 values in 1996 (~10 mmol/kg CT (total carbon), compared with ~300 mmol/kg CT in 1987 and ~200 mmol/kg CT in 1992) could reflect a continuation of this degassing trend; RRC plume CO_2 measurements suggest that the magma supplying gases to the vents degassed substantially during the seismic event.

Petrology:

Rocks and sediment were collected using the Pisces V submersible during the RRC and LONO cruises. The RRC sampled a "young" breccia on the western rim of West Pit, yielding three of the freshest lavas collected from Loihi. The LONO cruises collected talus fragments, some with sulfides (pyrite, bornite, sphalerite) and amorphous silica coatings, in situ lavas, and sediment. The sediment consists of coarse black sand, Pele's hair, and paper-thin bubble-wall fragments produced by the reaction of fluid lava with seawater, mixed with planktonic foram tests.

The RRC lavas are low SiO_2 tholeiites, typical of recent Loihi lavas (Garcia et al., 1995). They contain 1 to 2 vol. % clinopyroxene phenocrysts (rare in Hawaiian tholeiites) and two chemically distinct populations of olivine. Some of the clinopyroxenes have inclusions of strongly resorbed olivine and reversely zoned rims. This reverse zoning and two olivine populations indicate magma mixing, probably just before or during eruption. MgO contents of these rocks range from 8.2 to 10.3 wt. % and the olivines are in equilibrium with these compositions, assuming 10% oxidised iron. The olivine inclusions in clinopyroxene apparently formed at moderate pressures (~2.8 kb) based on modelling of equilibrium crystallization of these rock compositions using the MELTS program (Ghiorso and Sack, 1995). Analyses of RRC glasses yield trace element ratios (e.g., La/Yb) which continue a decreasing temporal geochemical trend for young Loihi tholeiites (Garcia et al., 1995), supporting the hypothesis that they were recently erupted. These results indicate that the RRC rocks are young and were stored at 8.5 to 9 km (compared to 2-6 km depth for the nearby Kilauea magma chamber (Klein et al, 1987)) before being mixed with a more mafic magma, which may have triggered the eruption of these rocks.

Radiochemistry

The ages of two fresh-appearing RRC lavas are being determined using the 210Po-210Pb technique which can provide ages of lavas erupted within the past 2.5 years (Rubin, et al. 1994). Three to four analyses made several months apart are required to establish the age of the RRC rocks, so final ages will not be available until summer, 1997. At this stage we can conclude that the rocks were both erupted within the past year, that their minimum ages predate the July, 1996 swarm by up to 4 weeks, and the two samples are probably at least 1 month different in age.

Lead isotopes, 210Po, and other volatile metals in RRC particle-enriched sea water (0.22 g/L) are being analysed to detect anomalies expected from magmatic degassing of metals. Particulates show 10-40x enrichments of Pb, Po, Mo, Sb, As, Te and Tl relative to Loihi summit lavas, and a Pb isotopic composition indistinguishable from Loihi summit lavas, strongly implicating Loihi as the primary source of trace elements adhering to the particulates.

Shipboard 222Rn analyses during the LONO cruises revealed elevated water column Rn activities (60-75 dpm/100L) at 1000-1300 m depth and up to 30,000 dpm/100L in the vent fluids. This radon distribution is similar to that in 1993, indicating that any potential eruptive pulse of Rn in August had already gone by early October.

AT THE MOVIES/ON TV

Through the kind intervention of the Councillor West, we are able to reproduce a couple of movie reviews that will appear in Geolog. With apologies to Testudo, the editor of Ashfall has excerpted them to save space.

DANTE'S PEAK, 1997, approx. 108 minutes, colour

I was pleasantly surprised when I actually got around to seeing *Dante's Peak* in its entirety. Between the trailers for the movie, as well as various clips I'd seen on talk shows, I suspected the worst; good concept, okay effects, terrible execution. Instead, I saw a good movie that was probably the best volcano feature film we are ever likely to see from Hollywood. One must remember that this isn't a documentary. It is a big-budget film with big name stars, made using the action adventure formula, all designed to rake in big bucks. If it weren't for the success of the Natural-Action-Adventure Film *Twister* last year, we might not even have *Dante's Peak.*

The story is simple; your average one-hour TV show has more complicated plot lines. To a certain extent, it is like *Jurassic Park.* It has scientists; it has kids; all you have to do is to substitute an active volcano for the dinosaurs. Harry Dalton (Pierce Brosnan), a volcanologist with the USGS Cascades Volcano Observatory, is called back from vacation to investigate rumblings at Dante's Peak, a dormant volcano supposedly located in the US Pacific Northwest (movie was shot in Wallace, Idaho). He arrives in town on the day that the town is receiving an award for being the 2nd best place to live in the United States (under 20,000), a town that hopes to become number 1 next year, in part due to a major investment (we are never told what) by an outside businessman.

Harry hooks up with the mayor (Linda Hamilton) for a tour of the town, and we get introduced to the local sights, her two kids, their dog, and her cranky mother-in-law. During this exercise, we see the first signs of volcanic unrest - dead squirrels and trees, presumably gassed by CO_2, as well as a couple of hikers who got parboiled in the local hot springs. Harry calls for the rest of his USGS associates to come up from Portland. Meanwhile, Harry gets the Mayor to call an emergency meeting of the Town Council to discuss evacuation of the town. Harry's boss arrives in time to squelch this idea, and to bawl Harry out for being premature in calling for an evacuation. The boss notes to the Council that a similar situation occurred at Mammoth Lakes; no eruption occurred but the damage had been done. The economy of the region was affected for years. Any call for evacuation would be based on science, and nothing else. *And so the scene is set, write your own scenario or see the next issue of Geolog*.

Although it might not sound like a great story, it is well executed. The characters are likable, the scenery and the soundtrack are great, the special effects are excellent (even most of the lava shots look real - only those showing the cabin being engulfed have that computer-generated look), and the dialogue is at least believable, even between the volcanologists. What is lacking is any real discussion of science (which should be taking place in the bar where the USGS guys congregate each evening). Then again, it would probably cause the audience to fall asleep.

One thing the audience might learn from *Dante's Peak* is that volcanic prediction isn't easy, that more stuff comes out of a volcano than just lava, and that the USGS are the good guys. Whether the real USGS has the funds any more to do the things they are doing in the movie is an entirely separate issue. One can't knock a movie that shows geoscientists positively, as professionals free from any hidden agendas.

The errors. Some of these I noted, but others have come from a press release by the Puget Sound Chapter of the Association of Women Geoscientists. *See the full-length review in Geolog for these*.

Now, if we can just offer jobs to the future generation of geologists and volcanologists who are going to be inspired to enter the profession because of this film.

Ratings

Overall: A. I may be a little generous, but it could have been a lot worse.

Volcanologists: B+. Credible. All behave as professionals. Certainly eccentric enough to be real.

Special Effects: A. The new standard to be measured against.

Vehicles: A++. I'd like a field vehicle half as durable as these puppies.

Testudo

VOLCANO: FIRE ON THE MOUNTAIN, 1997, made-for-TV movie, approx. 95 min., col.

Even if you didn't like *Dante's Peak,* the one good thing you could say about it was "well, it could have been a lot worse". How much worse? ***Volcano: Fire on the Mountain*** worse!

I should have know better. After all, this movie was brought to us by the same guys who gave us the recent 4-hour TV mini-series *Asteroid*. In addition, if I were more cynical, I might have suspected that the release of this movie two weeks after the opening of *Dante's Peak*, during the February sweeps, and only a couple of months before the summer's release of *Volcano*, might have been an attempt to cash in on the genre before it gets stale, rather than mere coincidence.

You can guess the basic storyline. Long-dormant volcano lies near unsuspecting resort town that is in the process of attracting new commercial development to make it extremely rich. Brilliant, but erratic, geologist/volcanologist has gut-feeling that the volcano is going to blow, but can't convince their peers or superiors, let alone the skeptical and greedy townspeople, of the danger until it's too late "If I'm right, everyone up there is dead meat" - says our volcanologist, who isn't the type of guy to mince words. The volcano finally does its stuff, doing its best to wipe out most everyone except the volcanologist and those fortunate enough to be within his protective aura (You're definitely a goner if you say to the volcanologist "I guess you were right and I was wrong" after the eruption starts.).

What about the science in this film? With so much choice, what should one nit-pick about first? How about the opening scene. A deep, magma-filled fissure opens up on snow-covered mountain slope, swallows two skiers, and then closes without a trace. When the search party comes looking later on, all they find is a bent ski pole. No ash, no melted snow, no ground cracks, nothing. Although they do encounter some CO_2 gas which almost kills the entire search party except for the heroic efforts of the volcanologist (it just happens that the leader of the party is an old girlfriend, so he has a vested interest in these heroics. The girlfriend may "know the mountain, but I know what's underneath").

Oh, and I almost forget the clichés. After all, you can't have a volcano movie (okay, so *Dante's Peak* is an exception) without having to cross the lava river, channeled in a deep gorge, using some sort of rickety structure (suspension bridge, log, narrow rock ledge, *etc.*). Also, somebody always has to slip and almost fall in (knocking something in to cause lava to spray up, adding to the tension of the moment). Well, this movie is no exception, with the lava river flowing through a natural gorge carved in granite. Unfortunately, this scene was much better done in *The Devil At Four O'clock* and *Earth's Final Fury*, with better looking fake lava flows.

However, I might be too critical here. So now, how about emphasizing the good stuff in the movie for a change. We'll, at least during the earthquake, people have difficulty standing and the sheriff's truck goes off the road (after all, it is a M=7.6 quake). And there is the jelly donut volcano analogy, *i.e.,* filling in donut represents magma, if you squeeze hard enough, it bursts out. In this case, right into the mayor's face, which serves to destroy what limited credibility the volcanologist already had in town. Guess that's about it. What? Oh yes; it was filmed in BC, helping the Liberals to fulfill their promise of jobs, jobs, jobs and the NDP to keep the nonexistent deficit from being larger than it already isn't.

I didn't see any reference to volcanological consultants in the credits, however, these were the standard TV split screen, minute credits that you really aren't supposed to see in the first place. Either there weren't any, or those that did asked (wisely enough) to remain anonymous.

Rating

Overall: F. Unfortunately, not bad enough to be really funny. Some good moments of bad dialogue (examples above), but these are too few and far between.

Volcanologist: D. He is sort of cute, even if he is a dork.

Special Effects: D. To be fair though, the filmmakers have given the public what the public expects a volcano to look like.

Testudo

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APPENDIX: DARWIN AWARD 1996

Submitted by Mark Huffstetter (Engineer, KING 5 TV Seattle).

You all know about the Darwin Awards - It's an annual honour given to the person who did the gene pool the biggest service by killing themselves in the most extraordinarily stupid way.

Last year's winner was the fellow who was killed by a Coke machine - which toppled over on top of him as he was attempting to tip a free soda out of it.

And this year's nominee is:

The Arizona Highway Patrol came upon a pile of smouldering metal embedded into the side of a cliff rising above the road at the apex of a curve. The wreckage resembled the site of an aeroplane crash, but it was a car. The type of car was unidentifiable at the scene. The lab finally figured out what it was and what had happened.

It seems that a guy had somehow got hold of a JATO unit (Jet Assisted Take Off - actually a solid fuel rocket) which is used to give heavy military transport planes an extra "push" for taking off from short airfields. He had driven his Chevy Impala out into the desert and found a long, straight stretch of road. Then he attached the JATO unit to his car, jumped in, got up some speed and fired off the JATO!

The facts, as best as could be determined, are that the operator of the1967 Impala hit the JATO ignition at a distance of approximately 3.0 miles from the crash site. This was established by the prominent scorched and melted asphalt at that location.

The JATO, if operating properly, would have reached maximum thrust within 5 seconds, causing the Chevy to reach speeds well in excess of 350 mph and continuing at full power for an additional 20-25 seconds.

The driver, soon to be pilot, most likely would have experienced G-forces usually reserved for dog-fighting F-14 jocks under full afterburners, basically causing him to become insignificant for the remainder of the event. However, the automobile remained on the straight highway for about 2.5 miles (15-20 seconds) before the driver applied and completely melted the brakes, blowing the tires and leaving thick rubber marks on the road surface, then becoming airborne for an additional 1.4 miles and impacting the cliff face at a height of 125 feet leaving a blackened crater 3 feet deep in the rock. Most of the driver's remains were not recoverable; however, small fragments of bone, teeth and hair were extracted from the crater and fingernail and bone shards were removed from a piece of debris believed to be a portion of the steering wheel. It was calculated that this moron nearly reached Mach I, attaining a ground-speed of approximately 420 mph.

Ed. My own preference was for the two guys that went surfing in the Florida Hurricane.

So, we get to see the scientists set up seismometers, take COSEC gas measurements (badly, according to the experts), and just all around monitor the volcano. We at least get to see the crater of the peak (modern-day Mount St. Helens is the stand-in), so we get lots of great scenery. We also get to see them fiddle with "spiderlegs", one of those robot devices for exploring volcanic craters. The upshot of this exercise is to have the volcanologists up on the crater during an earthquake, causing one of them to get injured and require evacuation. This adds drama to the business, as well as pointing out the risks of field work in such areas. However, despite these little hints of activity, another week goes by with not much happening, so the USGS crew gets ready to head back to Portland (where the volcano can be monitored just as easily). In the meantime, Harry starts taking more than a purely professional interest in the mayor. After all, you can't have a Hollywood movie without a love interest (okay, so *Alien* is an exception).

Unwilling to let them go so easily, the volcano finally decides to contaminate the city's water supply, as well as show some harmonic tremor, just to keep them around. A school gym meeting is called to discuss evacuation and the National Guard is put on alert. The school gym meeting goes badly, as shallow quakes associated with phreatic and phreatomagmatic eruptions of the volcano destroy the gym, large parts of the town, access to the interstate highway, *etc*. Ash starts falling!

Normally, this would be the end. Everybody would leave the now battered town, including the volcanologists, and we'd have a pretty dull ending. Therefore, to make things more exciting, the Mayor's mother-in-law won't leave her mountain cabin on the mountain, so the Mayor's kids commander a car and go up to get her. Harry and the mayor follow, fording raging rivers, avoiding crashing helicopters, falling ash, and landslides to get to the cabin to rescue the kids. (An aside: The helicopter crashes due to volcanic ash in the turbines, as the greedy pilot is trying to make $15,000 a person flying people out of town. Like the lawyer in *Jurassic Park,* not a tear is shed when it crashes).

Like any good action adventure or horror film, once they get to the kids, it is only time for the real adventures to start. This includes escaping a pahoehoe flow that engulfs the cabin and their vehicles. They escape the flow by boat across a lake, which turns out to have gone acid. The metal boat rapidly corrodes and the motor gives out, but they are able to reach shore in time, but not without injury to the only expendable person they have along, the mother-in-law (kids are untouchable, as are the hero and heroine). They eventually find a truck, and start heading down the mountain, only to find their path blocked by a pahoehoe flow. However, these guys have Vulcan-tough trucks, and they manage to drive it over the flow, rescuing the kids' dog at the same time. They get to town to find the bridge over the river destroyed (This had happened in the meantime, due to a lahar, which claimed Harry's boss, but not the rest of the USGS team. That's what you get for doubting Harry Dalton, volcanologist.). While deciding what do to next (all the while driving around town on burned out tires), the cataclysmic eruption occurs, and they have to outrun a pyroclastic flow. This they do by driving into an old mine shaft. All is not over, as we get a few cave ins for good measure, and our hero is subjected to more torture and abuse than most people would be able to bear (however, this is perfectly normal in action adventure movies).

How do they get found, you ask? Well, they just happen to have a special radio transmitter which allows them to be located, and dug out by the combined National Guard forces of several states, most of whose sole purpose is to clap and cheer loudly as the hero and heroine make their appearance (after all, this is a Mayor and Harry Dalton we are rescuing, not just anyone).

1. The real CVO office isn't shown, and it is in Vancouver, WA, not Portland, OR. Although, if one looks closely on the office window, one sees a *World Weekly News* cover featuring the face of Satan in a volcanic eruption cloud - that has got to be real, not an add in.

2. The seismograms don't show typical harmonic tremor.

3. People are able to walk and drive normally during the earthquake (which destroys almost all standing structures).

4. Vehicles drive through ankle-deep ash far too easily (however, all these vehicles are superhuman in character).

5. Cascades volcanoes ***DON'T*** erupt fluid basaltic lavas. However, they are far more dramatic than an aa flow. Even so, if these guys can drive a truck over a pahoehoe flow, I'd love to see them try it on an active aa flow! In fact, the film quality (and vegetation) changes at this point, and it looks like they really did drive a truck over a Hawaiian pahoehoe flow to generate some of this footage.

6. The lake becomes too acidic far too quickly. *(Plus, I'd love the formula of a naturally occurring acid that can dissolve aluminum that quickly; I'd make a fortune from Alcan - ed)*

7. It is unclear if the "volcanic rock" Harry picks up and looks at is volcanic or sedimentary. But at least he is looking at rocks. And he can identify crystals!

8. After spending several days in a mine shaft without access to water and suffering a compound fracture, Harry Dalton is pretty limber (most of us would be dead, or in severe shock).

9. Not an error really, but they use Mt. St. Helens for the pre-eruption scenery, and the final few shots of the volcano is the immediate post-1980 eruption landscape of Mt. St. Helens.

10. Not an error, but no volcano movie cliché scenes!

However, these are small potatoes compared to what could have been, all due in large part to the consulting volcanologists Jack Lockwood, David Harlow and Norman MacLeod. I'm pleased to say they actually are credited prominently in the film, about 1/3 of the way through the credits, and not buried in the fine print along with the copyright laws and other legal disclaimers at the end of the credits.
That leads us to nit number 2. Whatever happened to SO_2 in volcanic systems - *nada*, not a trace. CO_2 is now the volcano killer-gas of choice. I guess it's more dramatic because it is colourless and odourless. And in this movie, it isn't restricted to collecting in hollows or enclosed areas. It accumulates on wind-swept slopes and comes bursting out of the ground in gas fissures as need be for dramatic effect.

Nit number 3. The volcanologist, Peter Slater. His claim to fame is that he predicted an eruption at Kilauea, but blew the prediction at Mount Shasta. Thus, his boss doesn't trust his prediction that the volcano at "Angel Lakes", California is going to blow (Angel Lakes is meant to be a substitute for Mammoth Lakes, CA). Of course, to the audience, this sounds like a 50% success rate, however, it would be a much more impressive record if he had gotten Kilauea wrong, but Shasta right! Worst of all, he doesn't look at rocks, and whenever he can avoid it, the volcano itself. Much better to try and figure out what is happening on a computer screen than actually to look at any aspect of the eruption. His idea of field work is to climb up the mountain to look for signs of activity and, when he finds any, to run away. When he finally does get himself sent to the mountain to observe so that he can convince his boss that he is right, does he ever contact the office with this information? No. Sort of seems to defeat the purpose of his being there. After all, the head of the California Geological Survey is likely to carry a little more weight when it comes to calling for an evacuation than does this character. Especially after he gets jelly all over the mayor (see below).

Nit number 4. In this town, if you have to go somewhere far away on the mountain, you walk through the snow, without snowshoes, although you are occasionally allowed to use skis. The area is a ski resort, so the mountain is basically covered with snow all over, so why these guys try to go hiking through all that snow is beyond me. However, if where you have to go is within earshot, then you can use a snowmobile. Of course, this snow is incredibly resistant to heat, so even with all the eruptive activity that takes place, none of it melts or tuns to water (or forms mudflows, lahars, *etc.*).

Nit number 5. It really isn't a volcano movie. It is a disaster movie, in the *Poseidon Adventure* mode; namely, the cause of the disaster receives minor attention, the main focus is on rescue or escape of the motley crew of survivors. In this case, the everpresent pregnant woman at 8 months, 29 days (couldn't find any kids or dogs I guess); the greedy entrepreneur who will let everyone else in town die so he can save himself, *etc., etc*. In order to prevent outside help from biasing the survival odds, the road into town is conveniently cut by a landslide caused by a M=7.6 quake, and because of volcanic ash in the air (which is generally invisible, and doesn't seem to accumulate on anything. When it finally is added for effect, it looks more like snow or fog.), the town cannot be reached by helicopters. Problem is, disaster movies only work if you want to see these characters in the movie survive. In this film, one is rooting for the volcano.

So what if the volcanologist is a dork, and the movie isn't solely about the volcano? After all, who cares if the special effects are good? Well, they aren't. At one point, the volcanologist is explaining a pyroclastic flow. "Imagine a 10 foot high wall of scalding hot lava moving at 60 miles an hour" he says. So that's what we get. It's the closest thing I've seen to an computer-generated aa flow (one moving on very steep slopes, that is), but generally, it looks pretty awful. On the station I was watching, the local news followed the movie with a story on Montserrat ("The Real Fire on the Mountain"), and it occurred to me that maybe the filmmakers were trying to duplicate a block-and-ash flow. However, I think that is giving them far too much credit since, to stop the pyroclastic flow from destroying the town, the volcanologist and his girlfriend unleash an avalanche which stops the flow and saves the day (doesn't create any liquid water, only some steam as it quenches the flow). Of course, they are able to do this with a few sticks of dynamite, after a M=7.6 quake wasn't able to budge it, but that is just more nit picking. I suppose the quake may - ***must*** - have weakened it so as to make their job easier... None of this is as silly as these guys being in front of the avalanche once they get it moving, and having to outrun it, on skis (and doing it!). Plus, the volcano itself looks really fake, as do its explosions