

volcanism, though in my opinion responsible and quite likely, is certainly not proven.

At the Chaluka site that underlies the contemporary Umnak Aleut community of Nikolski, archaeological excavations have revealed a 4000-year occupational history pertaining to the cultural and biological ancestry of the modern Aleut. Deep in the deposit about 15 cm of ash, pumice, and clay are found that correlate with Ash IV and represent an episode of volcanism dated between about 3200 and 3000 years ago. There is some evidence that the emplacement of this ash was accompanied by a tsunami that inundated part of the site (Turner *et al.* 1974:133, 139). As noted previously, this ashfall correlates temporally with dated lava flows from Recheshnoi Volcano, and one wonders whether these events might be related. In an earlier interpretation that placed the ashfall (incorrectly, it now appears) some centuries earlier, Lippold noted that fish remains decreased significantly in proportion to sea lion and sea otter bones in the strata that immediately overlay the ash. Although noting continuity in bone tools between sub-ash and super-ash levels, she suggested that there was a hiatus in occupation marked by the ash and that volcanic activity might have been involved (1966:130). The economic shift still requires explanation but present evidence indicates that there was no significant hiatus in occupation. Indeed the most intensive occupation of the eastern portion of the site immediately overlies the volcanic ash with no apparent cultural or chronological break (Turner *et al.* 1974:139). Although one must remember that midden site stratigraphy and the vagaries of radiocarbon dating do not permit identification of the passage of decades, much less years, this evidence suggests that Chaluka, if it was abandoned temporarily after the ashfall and possible associated tsunami, was reoccupied almost immediately by bearers of the same cultural tradition. Thus available evidence suggests that the historical significance of this disaster was minimal, however inconvenient it may have been. By 3000 years ago cutting of the modern strand-flats and reef system was completed and intertidal invertebrates were available in quantity to the ancient Aleut (Black 1976:9). I suggest that by then, if not before, ancestral Aleut population and settlement density in the eastern Aleutians had reached a level where a localized disaster affecting (or even annihilating) one or several settlements would have little far-reaching cultural or historical impact. A fitting analogy would perhaps be the internecine warfare of late prehistoric times when whole communities might be destroyed with little long-range effect. By this time, from the coarse-grained perspective of the archaeological record, there were simply too many Aleut and Aleut communities for localized extinctions to be recognized in significant cultural losses or modifications. Warfare indeed was probably more significant than natural disaster in this regard.

SUMMARY

The data reviewed in this chapter suggest that volcanism would have had significantly different effects in the interior of northwestern Canada and in the

eastern Aleutians. The boreal interior had a limited carrying capacity in contrast to the highly productive marine ecosystem of the Aleutians. This difference is reflected in the ethnographic population density figures and in archaeological settlement history. The interior was sparsely populated by small, highly mobile human groups, whereas large, sometimes closely spaced permanent villages characterize the Aleutians in places. Certain Aleuts had little choice but to live near active or dormant volcanoes, where they became subject to localized but truly catastrophic volcanic phenomena that could and doubtless sometimes did lead to instant death for numbers of individuals. Interior ancestral Indians lived and hunted far from the rare and inaccessible volcanoes and were subject only to ashfalls and related phenomena. Volcanism was endemic in the eastern Aleutians with major eruptions occurring every few years, whereas only two volcanic outbursts of note are recorded for the entire Holocene in the Yukon. The Aleut would therefore have been much more familiar with volcanic phenomena and possibly more hardened to their impact than the interior peoples, but without question more Aleut peoples must have suffered from their effects throughout Holocene time.

The ecological impact of interior ashfalls would have persisted until the terrestrial vegetation was restored to pre-ash conditions, a process taking minimally several years; the sea protected some marine resources from the initial impact and rapidly cleansed portions of an affected area, mitigating if not undoing the damage done. Accelerated erosion and other severe terrestrial impacts would not have the effect on a sea-oriented people that they would have had on a land-bound one. Limited data appear to support the subjective feeling that subarctic marine ecosystems are far more resilient than terrestrial ones; certainly the variety and quantity of food resources available to the Aleut differ by several orders of magnitude from the resources available to Indians of the interior. Though not wishing to minimize the localized consequences of volcanism in the Aleutian setting, I think it can be fairly stated that a much larger area would have been impacted more drastically and for a longer period of time as a consequence of the emplacement of the East Lobe of the White River Ash than was the case with even the major volcanic explosions in the Aleutians.

Seemingly against the foregoing generalizations, I advance the conclusion that sporadic volcanism in the interior had more historic significance than endemic volcanism in the Aleutians. Because populations were sparse in the interior, relatively few people would have faced death or removal as a result of this event. But because of this population sparsity, the loss of one or several bands would have been more likely to have significant cultural impact than the death of hundreds in the Aleutians. In the best of times, refugees may well have been harder to accommodate, given the meager carrying capacity of the interior, and the wanderings of a few small bands in search of new homes might have caused more strife than the displacement of several Aleutian villages. What happened to these few refugees and the people they may have displaced in turn is in the final analysis far more important than what happened

to a few hundred Aleut, quite simply because the interior refugees represented a greater percentage of the bearers of the cultural tradition. The very rareness of catastrophic volcanism in the interior may have enhanced its effect on out-migration, although it is also possible that its novelty might have led to apathy, shock and nonadaptive behavior (see the Sanpoil-Nespelem example cited on page 347).

These generalizations can be only indirectly tested at present. A suggestion has been made that the emplacement of the White River Ash 12 centuries ago may have been significant in the dispersion of certain Athapaskan speakers. Arguments of continuity between the technology represented by the Anangula Blade site and universally accepted ancestral eastern Aleut of 4000 years ago appear to indicate either that the Anangula people escaped extinction in the holocaust accompanying the formation of Okmok Caldera or that there were related populations in the area who escaped annihilation and carried on the cultural tradition. Although not fully documented archaeologically, by 3000 years ago there were probably too many people in too many villages in the eastern Aleutians for localized catastrophes to have had significant long-term impact on the subsequent development of eastern Aleut culture.

SUGGESTIONS FOR FURTHER WORK IN THE SUBARCTIC

Several profitable lines of further inquiry into the significance of volcanism in northwest North America suggest themselves. As earlier suggested (Workman 1974:252), more useful field data might be generated by incorporating detection of volcanic impact into specific research designs rather than having to deal, as now is usually the case, post facto with data gathered for other purposes. Because of the short-term if spectacular nature of volcanological impact on the living world, finer chronological resolution than is usual at present is needed if paleoenvironmental research is to help us confront some of our basic problems (see Mehringer *et al.* 1977 for an example). I believe that in the foreseeable future a profitable approach will continue to be the study of the impact of historic volcanic eruptions. A considerable literature, including anecdotal as well as scientific accounts, must be culled for the relatively few observations that have bearing. Then, armed with appropriate geological evidence bearing on the nature and severity of particular volcanic eruptions, environmental information indicating in detail what resources were being exploited by affected populations, and a sophisticated understanding of ecological relationships based on contemporary data, it should be possible to construct satisfactory models indicating, within reasonable bounds, what the ecological effect of a given volcanic eruption must have been. From a series of such modeling exercises dealing with particular volcanic events, we can proceed to make useful statements about the ecological significance of volcanism in a specified region through time.

Establishing the historical, as opposed to the ecological, significance of past volcanism is another matter. Basic to such understanding is a refined and chronologically controlled knowledge of areal prehistory immediately before and immediately after the volcanic episode in question. Hypotheses must then be generated regarding the cultural effects one might anticipate as a consequence of a volcanic eruption of a certain magnitude with a given probable ecological effect. Some of the more obvious effects to be anticipated are abandonment of the area, breaks in the local archaeological sequence, intrusive appearance of cultural complexes or traits derived from the affected area in the peripheries, and evidence of intensified interregional contacts synchronous with the volcanic event in question (see Sheets 1976 for an example). Evidence for immediate reoccupation of affected sites without recognizable cultural breaks is, given a sufficient data base, evidence against profound cultural impact, although the problem must be considered in regional rather than site-specific terms.

On a less ambitious scale, certain other approaches to the data appear to deserve testing. As we have seen, the significant problem of seasonality of eruption can be approached, if one is willing to make some simplifying assumptions, by comparing seasonal high-atmosphere wind patterns of the present with mapped ash distributions. We could advance our knowledge of the impact of ashfalls on Alaskan salmon runs by detailed studies of the appropriate fisheries records. The comparative approach that I have attempted in this chapter could be broadened by considering other subarctic volcanic areas with somewhat different indigenous subsistence economies—for example, Kamchatka with its aboriginal population heavily oriented toward riverine fishing. In considering the social impact of natural catastrophes, the growing disaster study literature could usefully be consulted (see Sheets 1976 for a brief review), although at this late date one can scarcely expect to obtain data on the reaction of hunting and collecting peoples to natural disasters. Acknowledging that geologists have taken the lead in addressing some of the problems considered in this chapter, we should also indicate that the prehistorian may well be in a position to aid the geologist and the volcanologist. A cooperative program of dating ashfalls, in which the archaeologist has at least a stratigraphic interest, and carefully tracing them to their probable source through geological studies and modern lithological techniques, may ultimately provide researchers with a much more thorough and useful record of Holocene volcanic activity in northwest North America than is presently available from limited historic records and geological studies. An accurate history of past volcanism would be of practical value for, among other things, long-range settlement planning (Crandell *et al.* 1975). The practical value of further study of the effects of volcanism on North Pacific salmon runs should also be obvious (Eicher and Rounsefell 1957:76).

In conclusion, I wish to state that in suggesting that volcanism should be taken seriously in considering the environmental and cultural history of several subarctic areas I do not propose an all-purpose tephra-ex-machina explanation

for complex problems, nor do I advocate cultural or environmental catastrophism as a substitute for painstaking multifaceted studies or disciplined scientific thought. I do believe, however, that in highly volcanic areas the impact of past volcanism on human life must be considered.

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