

# Seeing What You Know: How Researchers' Backgrounds Have Shaped the Mima Mound Controversy

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As the boundaries of science are pushed toward infinity, so has the ever-widening divide among ever-deepening disciplines. Though early scholars often shared a common language and context through which to filter controversies, the establishment of niche specialties has developed distinct and sometimes competing jargons and philosophies that continually morph through time. Even so, Earth remains steadfastly interdisciplinary in nature, leading to clashes between disciplines. Few controversies remain so entrenched in this divide as the origin of the Mima mounds.

Found in the Puget Lowland of Washington State, USA, Mima mounds have baffled geologic thought for over a century (Fig. 1). Clustering in the thousands along proglacial terraces, the Mima mounds are domelike ellipsoids composed of a sandy loam overlying relatively impermeable coarse-bedded gravels (Pope et al., 2020; Pringle and Goldstein, 2002; Goldstein and Pringle, 2020). Up to 2 m high and 12 m in diameter, the mounds are elongated parallel to the downslope gradient of the host terraces

(Tabbutt, 2016). Similar mounds, referred to by Washburn (1988) as “Mimalike mounds,” have been found extending across the Northwest United States into Midwest North America and to Africa and beyond (Johnson and Horwath Burnham, 2012). The discovery of Mimalike mounds in a plentitude of geologic environments, conditions, and compositions has led to a range of conjecture nearly as diverse as the mounds they describe (Johnson and Horwath Burnham, 2012), yet each model appears to be largely advocated by researchers based on their specialty.

Concentrating on the Puget Lowland glaciation, J Harlen Bretz proposed that the Mima mounds had been produced after differential melting formed depressions or “sun cups” in thin sheets of ice along proglacial terraces, which were later filled with sediment and left as mounds after the ice melted (Bretz, 1913). Though dissatisfactory to Bretz as a comprehensive explanation for the Mima mounds, the sun cups hypothesis has been revived several times, such as by pedology graduate student R.C. Paeth (Paeth, 1967) and most recently by

Quaternary geologists Robert Logan and Timothy Walsh (Logan and Walsh, 2009).

Rather than resulting from glacial conditions, some suggest mounds were produced from vegetation-anchoring of wind-blown deposits, in some cases following extended droughts (Seifert et al., 2009). Though proposed to explain mound topography in California (Barnes, 1879), Quaternary geologists in the American Midwest have become major advocates of the aeolian model of mound formation (e.g., Slusher, 1967; Seifert et al., 2009).

On the other hand, biologists Walter Dalquest and Victor Scheffer hypothesized that the mounds resulted not from geologic activity but by bioturbation. Dalquest and Scheffer (1942) proposed that a sandy loam overlying the proglacial terraces became a locally thickened biomantle around activity centers of burrowing rodents. This idea has become a favorite among biology and geography researchers in the Mima mound controversy and has been applied to a number of sites in North America and elsewhere (see Johnson and Horwath Burnham, 2012).

The most recent model to have been developed was forwarded by Andrew Berg, a geologist in Washington State. Berg (1990) proposed that earthquakes mobilized loose sediment into concentrated heaps, forming mounds. Though the hypothesis has not been further developed in the literature, it has amassed a following of Pacific Northwest geologists, particularly those interested in earthquakes and volcanism resulting from the Cascadia Subduction Zone.

While most advocates adhere to models relying on data within their discipline, some models have been overturned by experts within the same field. A popular model in the mid-twentieth century propounded that mound topography resulted from polygonal permafrost cracking and subsequent melting of ice wedges, as seen in current periglacial environments. Eminent periglacial geologist A.L. Washburn organized a conference in the



**Figure 1.** At their type locality in Washington State, Mima mounds are a locally thickened sandy loam up to 2 m high, clustering along proglacial terraces. Similar mounds have been found across the world in a plentitude of geologic environments, which has led to a range of hypotheses nearly as diverse as the mounds they describe.

1980s focusing on the origin of the Mima mounds within periglacial settings, concluding that such a model was insufficient for explaining the Puget Lowland mounds and other sites (Washburn, 1988). With the abundance of competing models, some have proposed a polygenetic approach, yet even these models can be based on a dominant theme augmented by lesser models (such as the Dalquest-Sheffer-based polygenetic model of Johnson and Horwath Burnham, 2012). Even so, it remains uncertain if the disparate mound fields share a common origin at all, rather than causes specific to the site.

Representing a host of specialties, these models continue to fuel a vibrant controversy, exemplifying the Method of Competing Hypotheses (Chamberlin, 1890; Elliott and Brook, 2007). Based on the proposition that rival models enhance research within a scientific discipline, this method has resulted in such a fruitful debate for two primary reasons. First, the multidisciplinary research results in a variety of ideas and enhances creativity, expanding the range of research. Conversely, the competing models create a check-and-balance system—the expansion of research in one field provides data to be accounted for in models held in another discipline, thereby constraining the range of conjecture on the mounds' origins.

This equilibrium of enhancing geologic thought and constraining speculation generates a dynamic mode of inquiry. The ready exchange of information can lead to a revolutionary development of a debate. Such a position is commendable to any controversy because it prevents stagnation (Chamberlin,

1890). On the other hand, the Mima mound controversy cautions that sometimes researchers may be biased by their specialty. To advance, we must be prepared to consider data beyond our field of expertise and integrate it into our own.

#### REFERENCES CITED

Barnes, G.W., 1879, The hillocks or mound formations of San Diego, California: *American Naturalist*, v. 13, no. 9, p. 565–571, <https://doi.org/10.1086/272405>.

Berg, A.W., 1990, Formation of Mima mounds: A seismic hypothesis: *Geology*, v. 18, p. 281–284, [https://doi.org/10.1130/0091-7613\(1990\)018<0281:FOMMAS>2.3.CO;2](https://doi.org/10.1130/0091-7613(1990)018<0281:FOMMAS>2.3.CO;2).

Bretz, J.H., 1913, Glaciation of the Puget Sound Region: *Washington Geology Survey Bulletin No. 8*, 244 p.

Chamberlin, T.C., 1890, The method of multiple working hypotheses: *The Journal of Geology*, v. 15, p. 92–96. [Reprinted in *Science*, 1964, v. 148, no. 3671, p. 754–759, <https://www.jstor.org/stable/1716334>.]

Dalquest, W.W., and Scheffer, V.B., 1942, The origin of the Mima Mounds of western Washington: *The Journal of Geology*, v. 50, p. 68–84, <https://doi.org/10.1086/625026>.

Elliott, L.P., and Brook, B.W., 2007, Revisiting Chamberlin: Multiple working hypotheses for the 21st century: *Bioscience*, v. 57, no. 7, p. 608–614, <https://doi.org/10.1641/B570708>.

Goldstein, B.S., and Pringle, P.T., 2020, The Tanwax-Ohop Valley flood and debris flow, an Ice Age flood from the Cascade Range into the southern Puget Lowland and likely source of sediments for the Mima Mounds [abstract]: *Geological Society of America Abstracts with Programs*, v. 52, <https://doi.org/10.1130/abs/2020AM-358056>.

Johnson, D.L., and Horwath Burnham, J.L., 2012, Introduction: Overview of concepts, definitions, and principles of soil mound studies, *in* Horwath Burnham, J.L., and Johnson, D.L., eds., *Mima Mounds: The Case for Polygenesis and Bioturbation*: Geological Society of America Special Paper 490, p. 1–19, [https://doi.org/10.1130/2012.2490\(00\)](https://doi.org/10.1130/2012.2490(00)).

Logan, R.L., and Walsh, T.J., 2009, Mima Mounds Formation and Their Implications for Climate Change: Northwest Scientific Association, 81st Annual Meeting, p. 38–39.

Paeth, R.C., 1967, Depositional Origin of the Mima Mounds [M.S. thesis]: Corvallis, Oregon, Oregon State University, 61 p.

Pope, I.E., Pringle, P.T., and Harris, M., 2020, Investigating the Late-Glacial Tanwax Flood—A Lithologic Study of Sediments in Selected Mounded Terraces in the Puget Lowland: *Geological Society of America Abstracts with Programs*, v. 52, no. 6, <https://doi.org/10.1130/abs/2020AM-358073>.

Pringle, P.T. and Goldstein, B.S., 2002, Deposits, erosional features, and flow characteristics of the late-glacial Tanwax Creek-Ohop Valley flood—A likely source for sediments composing the Mima Mounds, Puget Lowland, Washington [abstract]: *Geological Society of America Abstracts with Programs*, v. 34, no. 5, p. A-89.

Seifert, C.L., Cox, R.T., Forman, S.L., Foti, T.L., Wasklewicz, T.A., and McColgan, A.T., 2009, Relict nebkhas (pimple mounds) record prolonged late Holocene drought in the forested region of south-central United States: *Quaternary Research*, v. 71, p. 329–339, <https://doi.org/10.1016/j.yqres.2009.01.006>.

Slusher, D.F., 1967, “Pimple mounds” of Louisiana: *Soil Survey Horizons*, v. 8, no. 1, p. 3–5, <https://doi.org/10.2136/sh1967.1.0003>.

Tabbutt, K., 2016, Morphology and spatial character of the Mima Mounds, Thurston County, Washington: Northwest Scientific Association, 87th Annual Meeting, p. 91.

Washburn, A.L., 1988, Mima mounds—An evaluation of proposed origins with special reference to the Puget Lowlands: Washington Division of Geology and Earth Resources Report of Investigations 29, 53 p.

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