THE GEOGRAPHY OF ACOUSTIC (MUSICAL) SANDS

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INTRODUCTION

What is acoustic sand? Acoustic or sound generating sand is one of the least understood natural phenomena, and is known in different parts of the world as: singing sand, squeaking sand, barking sand, booming sand, whistling sand, and musical sand. Their physical character in terms of particle size, surface texture and shape have been discussed extensively in the literature (Lewis, 1936; Folk and Ward, 1957; Brown et al, 1961; Clarke, 1973; and Lindsay et al, 1976). According to Sholtz et al (1997), there are two types of acoustic members. "Squeaking" sands, which generate a fairly high frequency (>500 Hz) output and are found on shorelines, beaches and riverbeds worldwide. The second type, "booming" sands, generate a low (<100 Hz) to medium (c. 500 Hz) frequency sound and are associated with slope failure on desert dunes. The phenomena have been reported in the literature and folklore for nearly a millennia. A Chinese report dating from 880 AD records a festival of booming sand (Ton-Fan) and "singing sands" have been documented in Japanese folklore (Miwa et al, 1983). The first European report was by Marco Polo (1295) in his travels along the Silk Road. The earliest reports in the literature by Darwin (1889 (*1832*)) and Miller (1858) noted the uniqueness and rarity of the phenomenon, recent research suggests that acoustic sands are not rare. The distribution of acoustic sand has been given spotty recognition in the literature, though individual sites have been documented. Little has been compiled on geographic distribution and environmental conditions that produce the acoustic character.

DISCUSSION AND RESULTS

Musical sands are associated with two natural environments: deserts (arid), and coasts (humid). Deserts typically dry, often exhibit a "wet" season. Coasts, associated with humid conditions, can be arid and have weather cycles similar to deserts (Bowden, 1968). The climatic regime, and geographic location are necessary to determine how musical sands are created in nature.

Acoustic phenomena have been duplicated with both "conditioned" natural sand and "man-made" products (Brown et al, 1965; Goldsack et al, 1997). Sand particle size and texture influence the frequency of resonance. Relative surface roughness and/or a chemical coating (silica gel) appear as the most important characteristic, and influence acoustic output by controlling shear strength and angle of repose.

Herein, it is the intent to present the geographic distribution of musical sand, and identify the environmental conditions creating the phenomena of "musical" sand. The geographic distribution of "musical sand" invites a comparison with the climate and climatic cycle of each site. The grouping of known sites and comparison with weather station data allows depiction of the climate regime of a musical sand. The mapped musical sands are depicted in Figure 1.

CONCLUSIONS

Geographically the distribution of "musical" sands as depicted in Figure 1, shows the phenomenon on all continents. Sites are associated with both sere desert environments and lacustrine, riverine and oceanic shorelines. Musical sands (Leach et al, 1997) are formed by: 1. A wet cycle to "wash" or purify the sand; 2. A dry cycle, when combined with a wet cycle create conditions under which the "coating" (silica gel) on individual sand grains is chemically produced; and 3. A "windy" location to dry and polish the sand grains, and further, allowing a "stacked-up unstable position, allowing the generation of acoustic resonance upon slope failure or slip.

REFERENCES

Bowden, L.W. (editor), 1968, *Coastal Deserts* (UC Press, Berkeley).

Brown, A.E., W.A. Campbell, D.A. Robson and E.R. Thomas, 1961,"Musical Sand": The Singing Sands of the Seashore Part I," *Proceedings of the University of Durham Philosophical Society* **13** (No.21), 217.

Clarke, J.A.R.C., 1973, "Singing Sands," *New Scientist* **59**, 222.

Darwin, C., 1889, *Voyages of the H.M.S. Beagle Around the World (1832)* (Murray, London).

Folk, R.L. and W.C. Ward, 1957,"Brazos River Bar: A Study of the Significance of Grain Size Parameters," *Journal of Sedimentary Petrology* **27**(No.1), 3.

Goldsack, D.E., M.F. Leach and C. Kilkenny, 1997, "Natural and Artificial 'Singing' Sands," *Nature* **386**, 29.

Leach, M.F., D.E. Goldsack and C. Kilkenny, "Musical Sand Characterization," *Canadian Acoustic Association*, Windsor, Oct. 1997.

Lewis, A.D., 1936, "Roaring Sands of the Kalahari Desert," *South African Geographical Society* **19**, 33.

Lindsay, J.F., D.R. Criswell, T.L. Criswell, and R.S. Criswell, 1976, "Sound-Producing Dune and Beach Sand," *Geological Society of America Bulletin* **87**, 463.

Polo, M. 1295, edited by T. Wright, 1968, *The Travels of Marco Polo, The Venetian*, (AMS Press, New York) p. 101.

Miwa, S.,J. Hidaka and A. Shimosaka, 1983, "Musical Sand," *KONA, Powder Science and Technology in Japan*, 64-72.

Miller, H., 1858, *The Cruise of the Betsy* (Constable, Edinburgh) p. 58.

Sholtz, P., M. Bretz and F. Nori, 1997, "Sound-Producing Sand Avalanches," Internet.
Http://www-personal.engin.umich.edu/%7nori/boom/RMP.html

FIGURE 1. The global distribution of acoustic (musical) sand. Specific sites have been gleaned from the literature, obtained either by the researchers or others in the field. (a comprehensive, annotated bibliography of "musical" sand is in preparation).