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### **Geological processes and orchid biogeography with applications to southeast Middle America**

This contribution is a proposal for integrating geological observations, such as the chronology of arc volcanic activity in Nicaragua, Costa Rica, and Panama, in hypothesis forming and testing in interpreting the geographic distribution of orchids (and possibly other biota). Southeast Middle America (Nicaragua, Costa Rica and Panama) is a nexus of profound geological changes in the late Cenozoic (Pliocene to present, 0-5 million years ago): (1) Well known is the early Pliocene closing of the Panama Seaway and the rise of the Panamanian Cordillera and their effects on ocean circulation, weather, and faunal exchange across the isthmus. (2) Less well known is the Holocene opening and partial closing of the Nicaraguan Seaway presently represented by Lakes Managua and Nicaragua. (3) Arrival at the Middle American Trench of offshore volcanic islands (e.g., Isla Cocos), seamounts, and the Cocos volcanic ridge associated with volcanic processes at the Galapagos hot spot. (4) The rise of the Central Volcanic Range in Costa Rica, one of the youngest arc volcanic mountain ranges in the world (late Pleistocene to Recent) and hence its geologically recent effects on topography, rainfall distribution, air quality (from volcanic gases), and soil chemistries are also relatively recent and are distinct from those in the older, presently non-volcanic cordillera, such as the Talamanca, that are SW of the Central Volcanic Range. These changes not only are potentially important in orchid gene flow, but also may influence through chemistry such processes as mutagenesis, pollination, and germination. As such, their understanding may lead to useful hypotheses concerning orchid biogeography and to purposeful orchid surveys to test them. Conservation of the remaining orchid ecosystems is a critical requirement in order for such efforts to be successful.