'Golden Age of Geology', Plate Tectonics and the Metaluminous-Peraluminous Distinction

Monte Swan
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The second half of the twentieth century saw the convergence of the plate tectonic revolution, and multiple new technologies during a fundamental shift from analogue 'eyes-on-the-rocks' to digital 'eyes-on-the-screen'. Strong funding during this shift led to the formation of numerous industry geologic research groups supporting world-wide oil & gas and mineral exploration, the generation of massive amounts of geologic data, many discoveries and a thriving multi-generational geological in-person community. High risk characterized this time, with work in remote deserts, rugged mountains, and deep jungles, while 4-wheeling and camping in virgin wilderness with no phone or radio and paper maps--this describes the life of the geologist back then. It could be considered a 'Golden Age of Geology' and it is hard to imagine it ever happening again.

The *MagmaChem Exploration Company and Research Institute* was founded during this golden age with the mission of integrating the past and future with the new technologies. This was done by focusing on empirical data compilation and the systematic taxonomic organization of specifically magmatism and associated mineral deposit data. The result of this research was a source- and process-based, 7-fold, Linnean type, Magma-Metal Series, chemical classification of igneous rocks and mineral deposits ultimately developing and integrating into an empirically-defined petrotectonic model of a layered earth (Figures 1 and 2). Not only does this give plate tectonics higher resolution, but it increases its predictive power. For example, application to mineral exploration dramatically reduces risk, which led to the discovery of twenty mineral deposits on 3 continents worth one hundred and three billion dollars and could be considered an economic proof of concept (Figure 3). The 89-72 Ma Sevier-Laramide late Cretaceous paleo-tectonic map and cross section of the WUS in Figure 4 is an example of the integration of oceanic and continental plate motion data and the direct linkage of mantle sources and processes to crustal geology.

This presentation will present an overview of the results of MagmaChem's research and then focus on one of MagmaChem's most important distinctions--the plate tectonic settings and resource implications of: 1) moderate to steep, subduction-generated, metaluminous igneous rocks, mineral deposits and serpentinization; and 2) flat, subduction-generated, peraluminous, igneous rocks, mineral deposits and serpentinization (Figures 5 and 6).

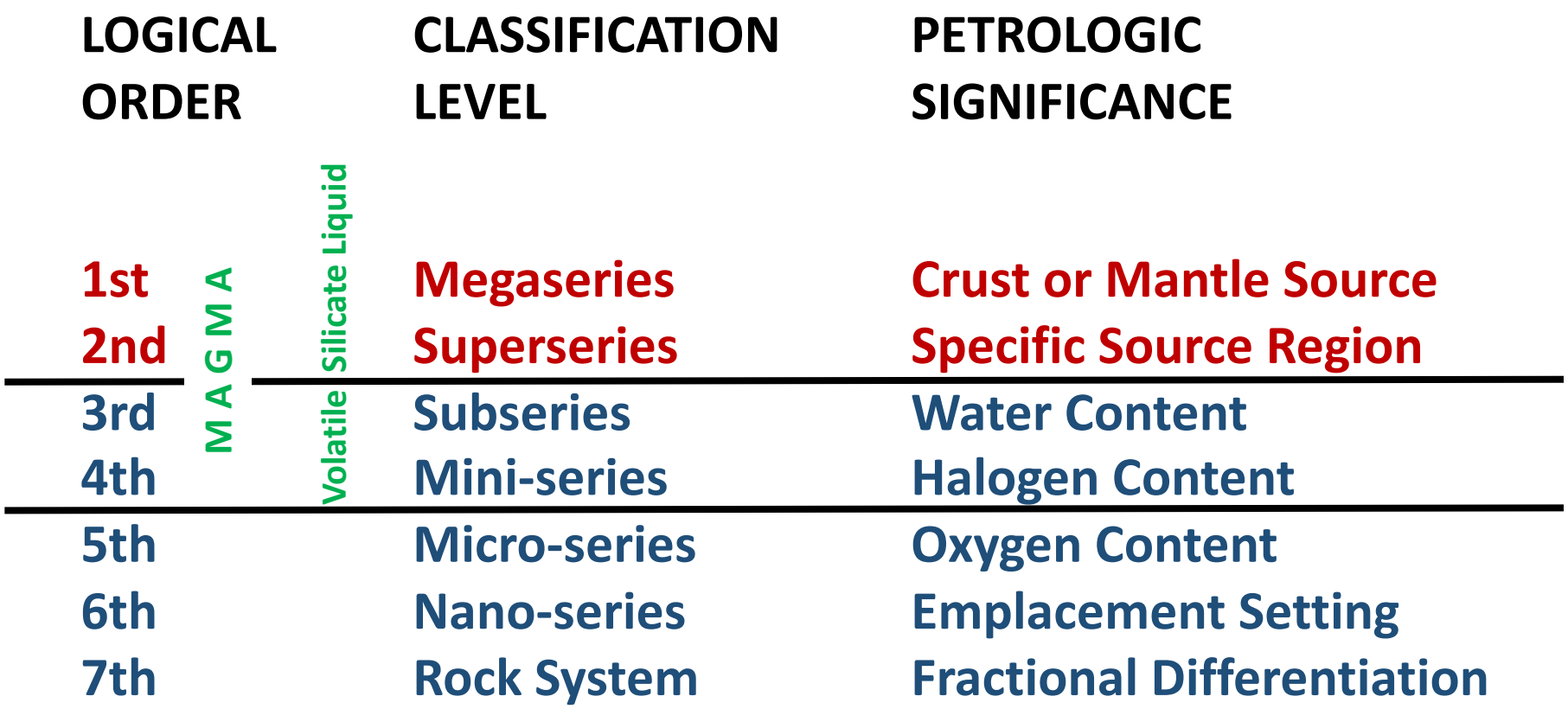

Figure 1: Taxonomic structure of the Magma-Metal Series Classification.

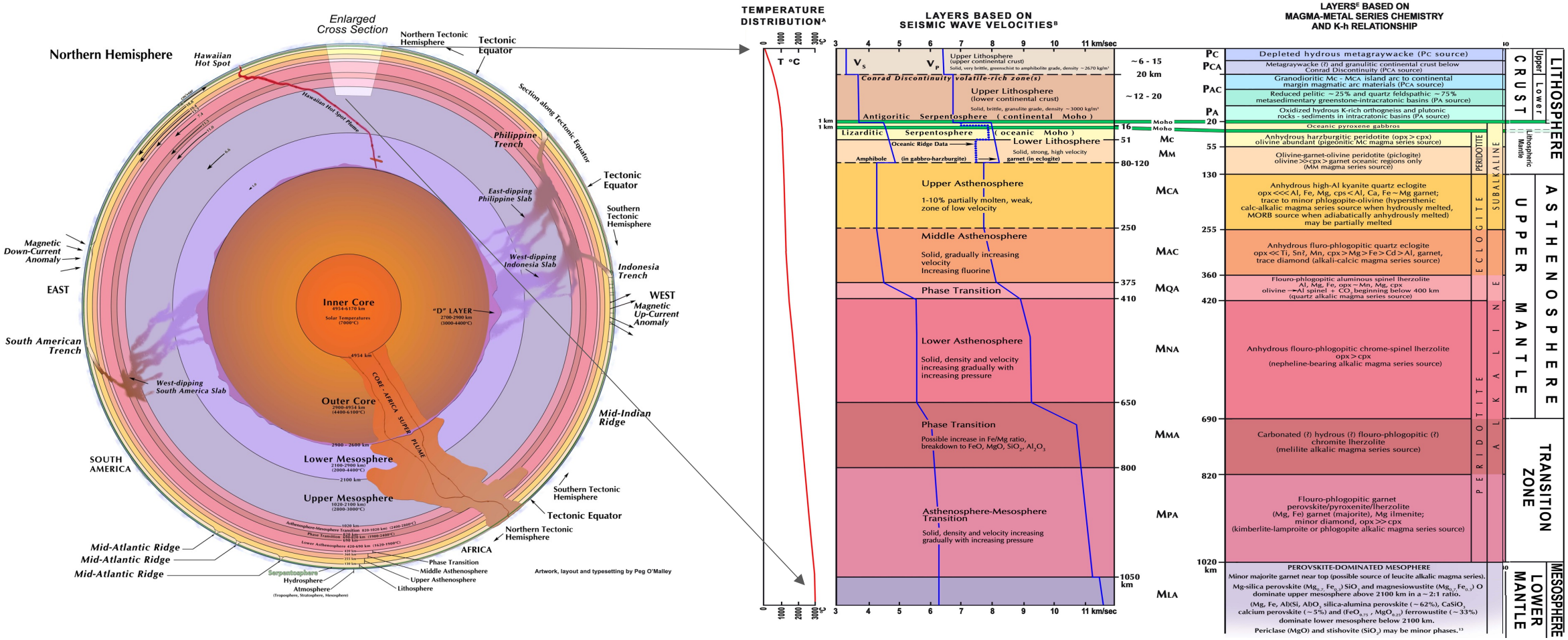

Figure 2: Magma-Metal Series Petrotectonic Model for a Layered Earth, comprising an 8-layered mantle with chemically distinct and physically immiscible layers.

Figure 3: MagmaChem client Cu-Au-Ag discoveries identified and targeted by MagmaChem.

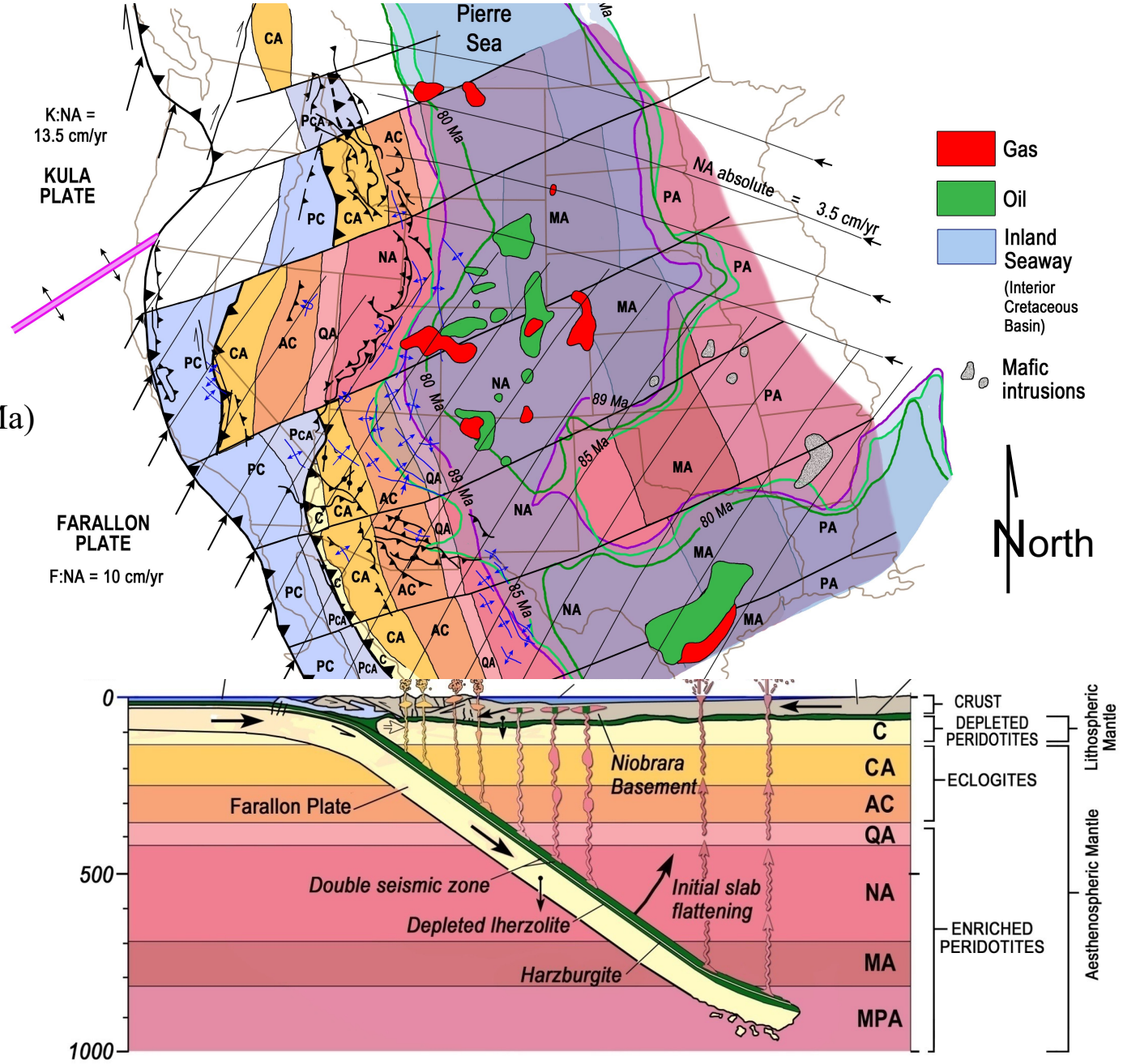

Figure 4: Sevier-Laramide, Late-Cretaceous (89-72 Ma) paleo-tectonic, time-slice map and cross section of the WUS showing integration of oceanic and continental plate motion data and the direct linkage of mantle sources and processes to crustal geology.

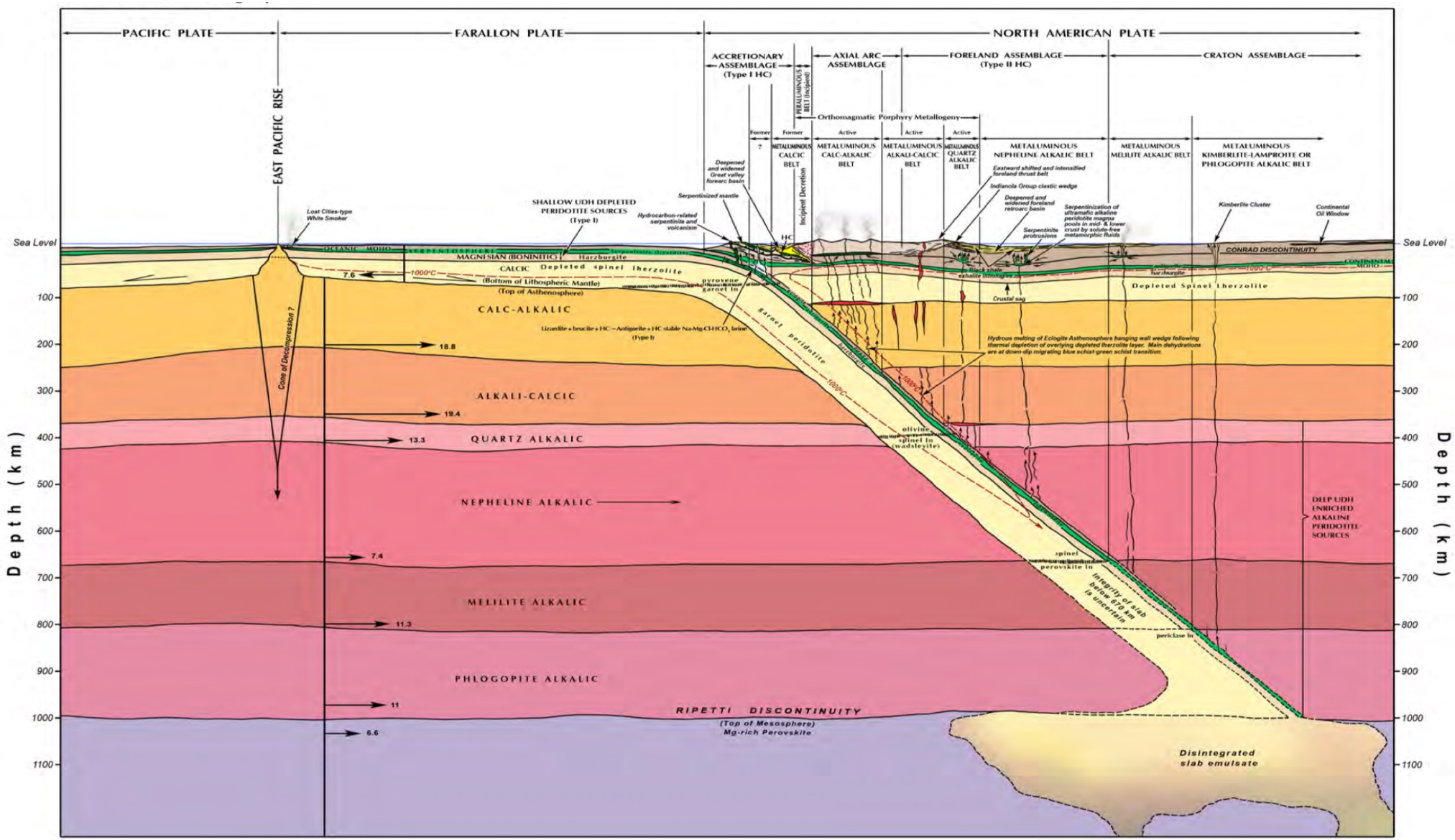

Figure 5: Schematic cross-section of Andean-Style Cordilleran Orogeny associated with end-on convergence and moderate-to-steep subduction, showing metaluminous magmatism and serpentinization of lherzolitic, alkaline peridotite associated with Type II oil.

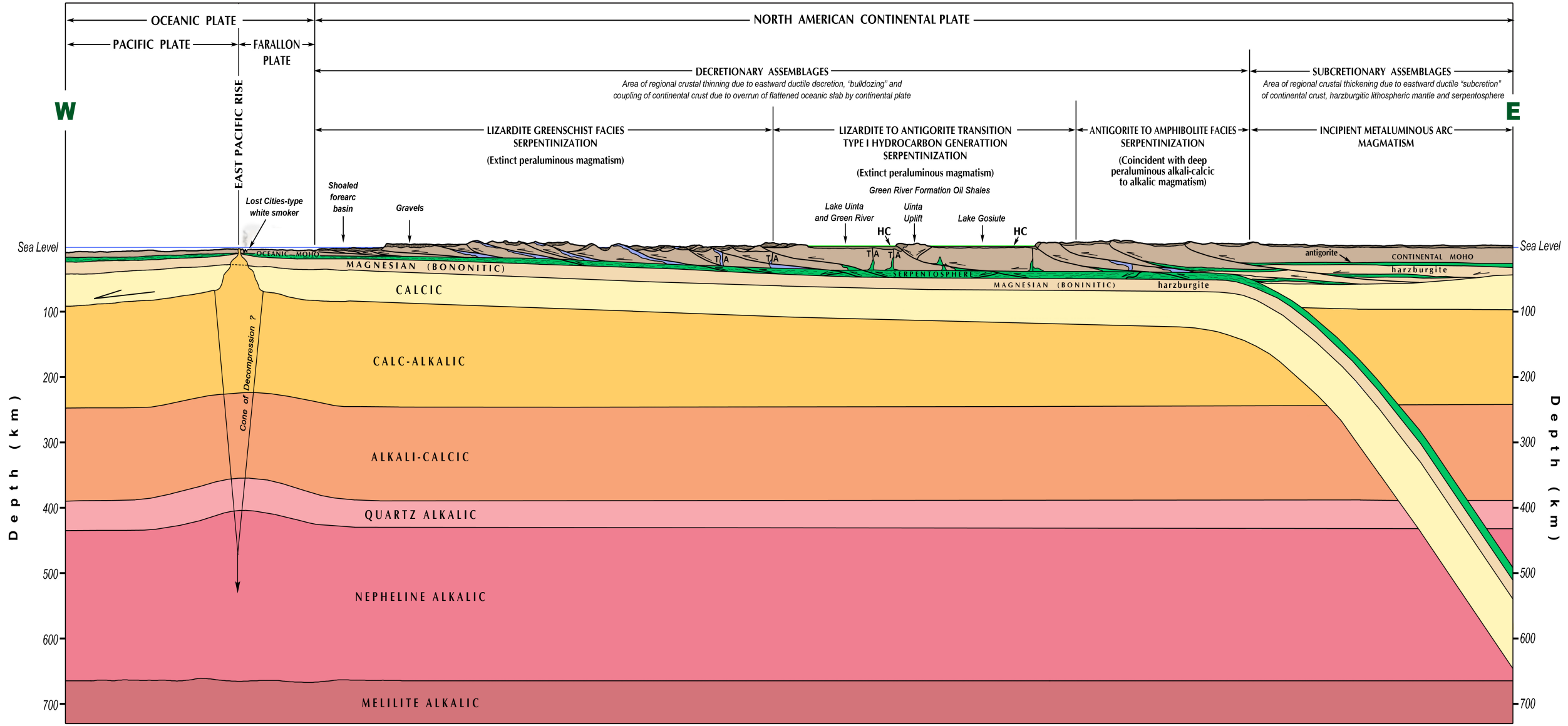

Figure 6: Schematic cross-section of Andean-Style Cordilleran Orogeny associated with end-on convergence and flat subduction, showing peraluminous magmatism and serpentinization of harzburgitic, sub-alkaline peridotite associated with Type I oil.

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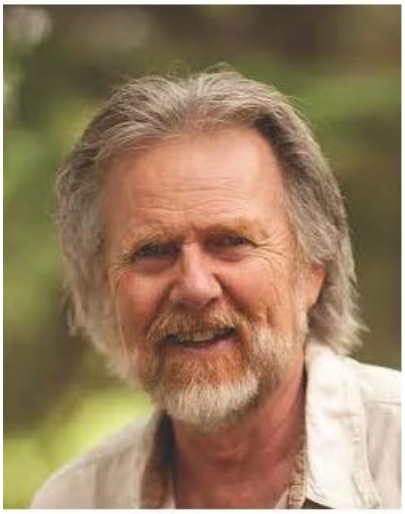

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Monte is a geologist with international mineral and petroleum exploration experience. He began his career as a research geologist for Kennecott's Geological Research Group focusing on basement lithology and structure and as an exploration geologist for Newmont Mining Company at the time of their initial major gold discoveries in Nevada. In 1983 he co-founded MagmaChem Exploration, LLC and helped built a client base to fund the MagmaChem concept. He is now president of MagmaChem Associates, LLC and co-founder of the MagmaChem Research Institute. He was instrumental in development of a broad client base to fund MagmaChem. His clients have included virtually all the major mining and oil and gas companies, in addition to groups such as the USGS and DOE. He has special interest in basement geology, kinematic analysis and fluid flow and has compiled large exploration databases for Mexico, British Columbia, the Western US, and Eastern Canada. He has been an adjunct professor, is a published author and has been an author or co-author for many of MagmaChem's 160 abstracts and papers and involved in many of the 11 theses and dissertations sponsored by MagmaChem. The MagmaChem technology has dramatically reduced risk for clients, directly contributing to the discovery of 20 economic gold-copper-silver deposits on 3 continents worth more than $100 billion.

Monte earned his B.S. degree in Geological Engineering from Michigan Technological University and M.S. degree in Geology from the University of Arizona. He has been a member and presented papers to numerous professional geologic associations such as: Arizona Geological Society (AGS), the Geological Society of Nevada (GSN), the Society of Economic Geologists (SEG), Denver Region Exploration Geologists Society (DREGS), Society for Mining, Metallurgy, and Exploration (SME), the Geological Society of America (GSA), the American Institute of Mining Engineers (AIME), the American Association of Petroleum Geologists (AAPG), and the Rocky Mountain Association of Geologists (RMAG).