

HYPSONOMETRIC TINTS AND TECTONIC COLORS: A NEW READING OF CLASSROOM WALL MAPS

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ABSTRACT. Hypsometric mapping of color tints for contour elevations is a source of constant confusion for geography students. The elevation colors are confused with vegetation, so that lowland green is read as rainforest, upland yellow is seen as desert and highland red is logical to mountains. Instead of countering these vegetation colors, a new coding using tectonic geology is introduced. Now, green "forests" are seen as sedimentary basins of fossil fuels, yellow "deserts" are understood as ancient platforms of gem stones and red "mountains" taken as tectonic zones of active earthquakes. Such tectonic color coding converts the confusion of hypsometric colors to modern geology and provides freshman geography students with a new power to read the familiar classroom wall maps.

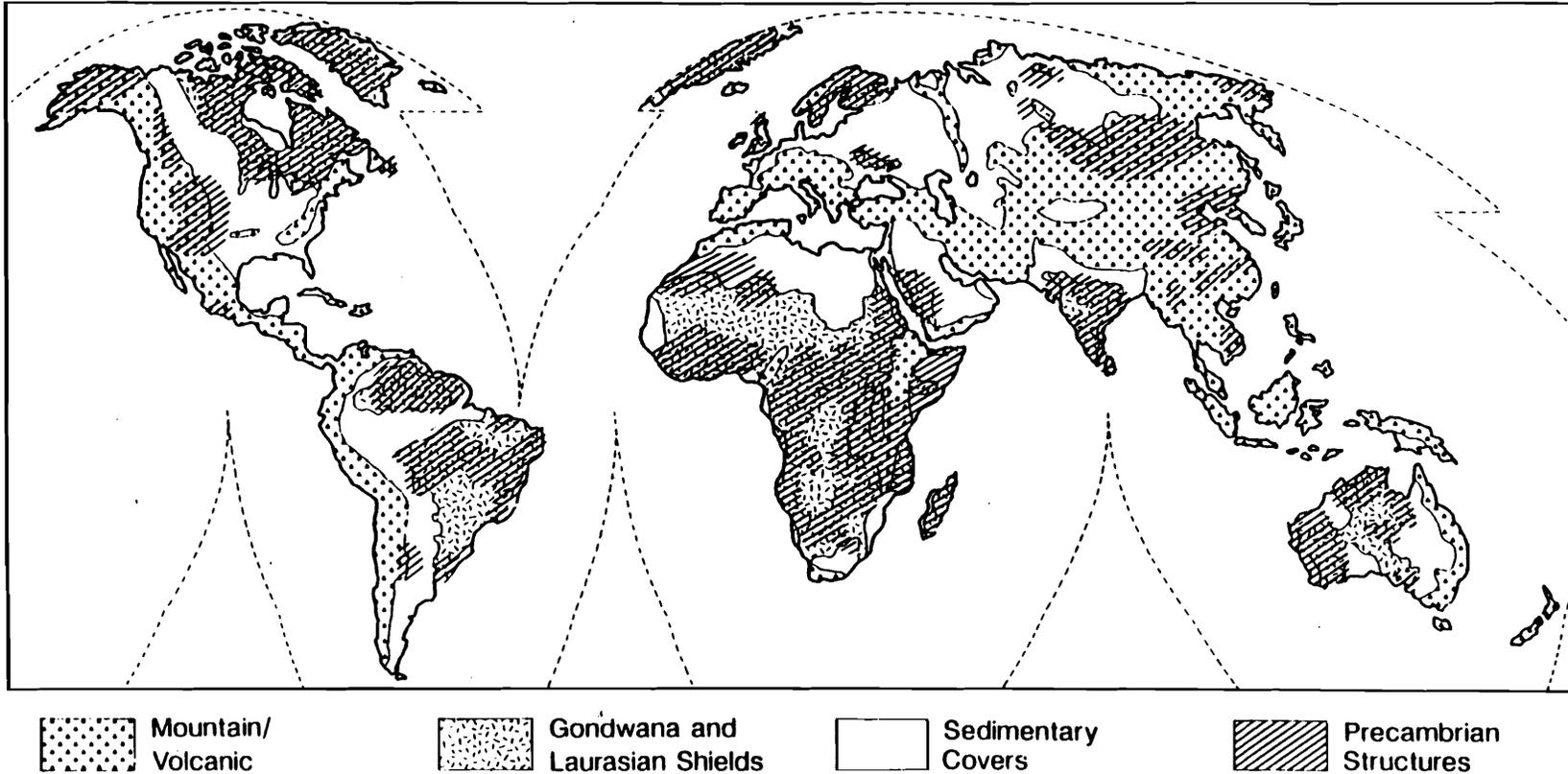
The familiar tints of hypsometric elevation colors are so common to geographers that their meaning is often lost to those outside geography. The standard classroom map of the world, such an accepted fixture of introductory geography courses, is frequently misunderstood by novice students who read the vivid colors as signets of vegetation and patterns of climate. This dichotomy between the ascribed meaning of the hypsometric elevation tints and the presumed meaning as vegetation colors promotes confusion of the classroom wall map and of geography. To correct this confusion, a new and innovative reading of the standard hypsometric map is offered that allows a more informative understanding of global patterns from the base of tectonic geology.

Hypsometric Tints

Hypsometric elevation tints date back to standard school atlases of the late 19th century, as full color American examples for elementary geography classes (Maury 1880). Cartographic origins are found in the 1840s with the first lithographic color printing (Robinson 1982:98-101). In turn, the innovations in contour mapping by French, German and English cartographers of the late 18th century had devised methods for showing mountain heights and lowland plains that permitted scientific calculation of slope and elevation (Robinson 1982; Lorange 1984). The result was standardization of the contour color tinting into the standard hypsometric wall map that is familiar today in most geography classrooms. Yet, the true meaning of the elevation tints is often lost to freshmen who see the inviting colors as patterns of trees and deserts, rather than height elevations. Green is equated with trees, yellow with deserts and red with mountains. When shown the shape of a familiar continent, such as South America from the Goode's World Atlas, the geography student sees apparent logic in the "green" tropical lowlands of the Amazon rainforest, the "yellow" drought regions of Northeast Brazil and the "red" peaks of the Andes (Espenshade 1989, 120). While the truth of regional rainfall patterns and vegetation might be taken from a choroplethic map, the introductory student sees parallels in color patterns for South America that tend to confirm the belief in green trees and yellow deserts are, in fact, equated with elevations. The same mistaken equation is seen in the colors of Australia, that again appear to match hypsometric tints of standard atlases, such as the new Hammond Physical World (Hoffman 1987).

In order to dissuade students from the mistaken belief in hypsometric tints as colors of climate and vegetation, a new approach must be taken through the patterns of tectonic geology. The recent understanding of global plate movements and the movements of continental blocks has brought insight to the meaning of elevation patterns at world scales. Certainly, the pattern of earthquake and volcanic activity has now been directly equated with the collision of crustal plates and the formation of high mountain

Figure 1. World Regional Landforms after Murphy (1968) showing overlap pattern of Precambrian structures after Condie (1989) and Leonov and Kain (1984) for plateau elevations. McClennen BUCL 1990



belts (Tarling 1975). At least, the instinct of freshmen to see red mountains as high elevations can now be equated with regional earthquake faults and zones of high risk damage and sudden disaster. Thus, the immediate thrust of red as a color of danger can be converted to tectonic understanding. Moreover, the high correlation with mining of gold, copper, tin and silver can give these red mountains immediate meaning to introductory students (Garson and Mitchell 1981). The vivid colors of the Andes now read for volcanoes and silver alike.

Tectonic Landforms

A pioneering pattern of tectonic colors with hypsometric tints is found in Murphy's (1968) original world Landforms map. Here, red mountains are defined as Alpine belts, green lowlands as sedimentary covers and yellow and orange plateaus as Gondwanian and Laurentian Shields. While the conversion of Murphy's original colors to the standard form in Goode's Atlas now reads Alpine mountains in purple-mauve, and volcanic belts in red, the basic hypsometric logic remains the same: that lowlands are green and mid-elevations are yellow or orange (Espenshade 1989, 6-7). At least, for the Sedimentary Lowlands, the link of green to sedimentary basins can be made for student appreciation, so that fossil fuel deposits of Saudi Arabia and the Persian gulf can now be clearly seen in the patterns of green lowlands (Espenshade 1989, 49,177). This pattern of petroleum geology, now converts green trees into oil reserves of the Mideast (Tarling 1975). Indeed, such gross equations might seem somewhat simplistic, but the green lowlands on the 19th century school atlases do point to later petroleum discoveries around the Gulf of Mexico, rather than false colors of the tropics (Maury 1880, 19).

The true problem of hypsometric conversion comes with the reading of mid-elevation plateaus from yellow deserts to ancient Gondwanian shields. Indeed, the recent Tectonic Map of the Earth by Condie (1989), shows a high correlation between the hypsometric yellow plateaus of the Canadian Shield and the red provinces of Precambrian rocks dated from 2.5 to 3.5 billion years old. Certainly the ages alone indicate geologic regions of great antiquity and great stability of survival. For South America and Africa the yellow plateau patterns, once again, appear to confirm underlying antiquity of the rock structure to Precambrian age. A similar pattern is found on the Soviet Tectonic Map of the World by Leonov and Khain (1984) that matches granites of 1.6 to 2.6 billion years in red with the general areas of Precambrian rocks on the Condie (1989) map for the Brazilian and Guianan shields.

While the approximation of mid-elevation plateaus with ancient Precambrian shields does appear to match, the underlying logic of geology is only recently been offered. In the Brazilian example of the abrupt descent from the plateau to the Atlantic shore at Rio de Janeiro, Cox (1989) has proposed that the sudden shear of elevation is part of a rift structure of basalt domes built up from the Mid-Atlantic ridge. This logic is based on the pioneering work by Cloos (1953) who saw the Red Sea rift as an opening dome of lava injection between East Africa and Saudi Arabia. In turn, Cox has seen similar split dome structures in Namibia, and South Africa (Cox 1989). This helps explain, in part, the standard mid-elevation heights of 2,000 feet (600 meters) that are seen for African hypsometric yellows and browns. While frequently confused with the Kalahari Desert, these rift dome structures do make sense of the plateau pattern in Southern and East Africa.

Within Africa, the key pattern of Precambrian shields is a more powerful device for explanation than the rifted domes. The great diamond mining zones of South, Central and West Africa show clearly on the Soviet Tectonic map for ancient granite rocks of the African provinces (Leonov and Khain 1984). A similar pattern of ancient shields is seen in Scandinavia and the Ukraine where iron mining is associated with these Precambrian provinces of Sweden and the Soviet Union (Espenshade 1989, 44). Indeed,

some of the rocks in Finland and the Donbas have been dated by Condie (1989) to over 3.5 billion years. For India, the Precambrian shield pattern is again similar, with ancient structures of iron and gem stones of South India and Sri Lanka. On standard hypsometric maps of the Goode's Atlas, the pattern of yellow plateaus does seem to confirm underlying shields, although the drought ridden Deccan can easily be confused as desert yellow by students (Espenshade 1989, 175). Here too, Cox has proposed a rifted lava dome from Gondwanian times when India was attached to Antarctica and South America, sliding into the Himalayan mass of Asia (Cox 1989:873-74).

When the regional pattern of ancient Precambrian plateaus from Condie's Tectonic Map are overlapped with hypsometric regions on Murphy's Landforms map the overlap between underlying yellow and orange mid-elevations and red provinces of Precambrian rocks is somewhat convincing (Figure 1). In areas such as India and the Americas, the Precambrian shields do tend to overlap with the mid-elevation plateaus, whether by logic of dome uplift, as in Brazil, or erosional survival as in Canada. When taken with Murphy's original Landforms cartography of South Asia and Australia the correlation between orange plateau shields and red granite Precambrian provinces does appear to fit the iron mining sites of Western Australia as displayed on the Goode's World Atlas (Espenshade 1989, 44,194). For Soviet mapping in Siberia and former Manchuria, the detail of known Precambrian structures is more complex and often confusing with the yellow plateaus of the Gobi Desert. Condie has generalized these Siberian patterns more clearly, and they do match, in part, with vast mid-elevation regions of the Anabar shield where recent Kimberly diamond pipes have been opened (Orlov 1977). Thus, for student observers, the vast yellow zones of Siberian tundra, can be realized as diamond districts of potential resource.

Conclusion

In the final analysis, the false colors of the hypsometric elevations can now be converted into classroom signets of true tectonic geology. No longer will green be read as tropical forests or yellow as dry deserts. Now the student, seeing the familiar wall map, can interpret valuable economic geology from the distant back row, indeed as a satellite observer. The colors show general patterns of petroleum reserves, earthquake belts and iron ores in the pattern of hypsometric tints that otherwise confuse the introductory eye to real geography. In this manner, the appeal of Victorian hues can be applied to the modern concepts of tectonic geology. Now the geography student can read the red mountains as earthquake zones, the green lowlands as fossil fuel basins, and the yellow plateaus as ancient gemstone rocks. The result is a simple, yet effective translation of hypsometric colors into an applicable economic geography based on tectonic patterns of the elevation tints. While the translation may be somewhat generalized for precise geology, the tectonic interpretation of old classroom wall maps, allows a positive reading of hypsometric colors as a powerful tool of geographic analysis. Moreover, the broad patterns of colors can be seen from the far distance of the rear rows, giving students incentive to trust their own new found geographic skills for regional analysis. In this manner, the geography students can learn to read the map colors on their own terms and trust geography as a science of logical patterns from its basic language of classroom wall maps.

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