**Historic Frontier Processes Active in Future Space-Based Mineral Extraction.**  
D. M. Gray, Frontier Historical Consultants, HC 85 Box 211, Grand View, ID 83624. dalegray@micron.net.

**Introduction:** The forces that shaped historic mining frontiers are in many cases not bound by geographic or temporal limits. The forces that helped define historic frontiers are active in today's physical and virtual frontiers, and will be present in future space-based frontiers. While frontiers derived from position and technology are primarily economic in nature, non-economic conditions affect the success or failure of individual frontier endeavors, local "mining camps" and even entire frontiers.

Frontiers can be defined as the line of activity that divides the established markets and infrastructure of civilization from the unclaimed resources and potential wealth of a wilderness. At the frontier line, ownership of resources is established. The resource can then be developed using capital, energy and information. In a mining setting, the resource is concentrated for economic shipment to the markets of civilization. Profits from the sale of the resource are then used to fund further development of the resource and/or pay investors. Both positional and technical frontiers develop as a series of generations. The profits from each generation of development provide the capital and/or investment incentive for the next round of development. Without profit, the self-replicating process of frontiers stops.1

**Igniting Frontiers:** Anthropologists have long known that three non-economic "environmental" factors cause societies to expand or contract. These can be termed: Technology, Social Systems, and Ideology. Studies in historic mining have modified these terms slightly to: Technology, Legislation and Charisma (TLC). The status of these three environmental conditions in society either enhance or diminish the cost of entering frontier while simultaneously increasing or decreasing the probability of success. Changes to these environmental conditions have resulted in expansion of prehistoric societies, historic civilizations, and most recently have been operational in the expansion of the society into the virtual world. They have also been demonstrated to be in operation in space-based frontiers such as telecommunications, Remote Sensing and Global Positioning (GPS).

The ignition of a frontier depends on participant's ability to enter the wilderness, obtain control of resources, and then economically develop infrastructure to extract resources and transport them back to markets in civilization. When this is done at a profit, the frontier is ignited. While investors can be persuaded to support frontier enterprises for several rounds of development, profits are the determining factor for the onset of self-replicating frontier development.

**Launch Bars.** The total perceived cost from first movement to first dollar can be termed the "Launch Bar". This is not a hard number, rather is a projection based upon business realities blended with assumptions on the nature of the undeveloped wilderness resource. If potential returns are judged to be adequate and sufficient investment capital is in place, then first movement into the frontier may take place. Each civilization / wilderness interface is unique and as a result, the development of a frontier is difficult to predict. However, understanding of the ramifications of Launch Bars provides some measure for the timing of events and even the ultimate success of frontier efforts.

Research in historic mining frontiers in the Northern Rockies has determined that there is a direct link between the speed of frontier development and the height of the Launch Bar. The higher the bar, the slower the frontier will develop. There is also a connection between the Launch Bar and the number of participants in a frontier. The higher the bar the fewer the participants. For example a space-based telecommunication venture currently requires about $100 million to begin services. Business plans are measured in years and there are less than 100 companies active in this arena. On the flip side, a $400 used computer and an Internet hook-up can set up a business trading on e-Bay. As a result, Internet businesses develop in months or even weeks with a vast number of e-commerce start-ups each day.

The TLC environmental conditions actively move the Launch Bar up or down. This in turn alters the pace of frontier development and changes the number of participants. The invention of the cyanide milling process is a prime example of how technology created a boom in western mining (Technology). The passage of the 1872 mining law regulating the establishment of mining claims allowed mining companies to effectively control the ownership of their mines and thereby have collateral for loans (Legislation). The cry of "GOLD" in 1849 caused men and women from around the world to drop what they were doing and rush to the California gold fields (Charisma).

Launching a frontier endeavor does not assure the sparking of a viable frontier. The American West has many examples of failed mills rotting in the
wilderness. There are as many reasons for frontier failure as there are failures. Under capitalization, overcapitalization, poor business practices, changes to markets during development are some of the more prominent causes of failure. When a prominent frontier enterprise fails, it often causes a catastrophic drop in the Charisma of the individual frontier. These were historically termed, "Humbugs"; however, this term has recently been replaced with "Iridium Effect". The effects of a humbug can sour a frontier's access to investment capital for a generation of investors.

**Frontier Mining Development:** Frontier mining has traditionally fallen into three categories: Subsistence, Speculative and World-Class. The size of the resource and the capital required to develop it determine which approach is used. Subsistence mining is typified by small-scale placers that supplement a single family's income over a long period of time. Speculative mining typically starts at Subsistence levels, but by a series of speculative steps develops the resource to an appropriate level. World-Class mining ventures utilize large capital reserves to study, plan and then develop large-scale facilities to process resources efficiently. Each of the categories has its place in development of mining resources. However, because of the high Launch Bar in any space-based mineral extraction, only the World-Class category would be applicable to open up the frontier.

Another ramification of the Launch Bar for World-Class ventures relates to failure rates. As the Bar moves up, failure rates move downward. Low Launch Bar mining endeavors in the American West had failure rates around 90 percent. High Launch Bar endeavors approached even money. Recently, in space, the $5 billion Iridium frontier enterprise demonstrated that even extremely high Launch Bar attempts to open a new frontier can and do fail.

Part of Iridium's problem was market timing, by the time their business plan had unfolded; terrestrial-based cell phones had absorbed most of their potential market. However, any primary frontier endeavor will have a high initial Launch Bar and will carry high risk. Once a new (or primary) frontier has been established, the base of the launch bar is raised for subsequent secondary frontiers. For example, once the California gold mining frontier was established, the base level for the Launch Bar on the Nevada silver frontier was effectively raised. Once a single dollar of profit has been made from a new frontier, investors look at the frontier as a source for high return on investment, rather than a dubious venture into the unknown. Speculative development then becomes possible.

**Raising the Base:** While frontiers are extensions of society into new, previously untouched areas, they do not spring fully formed from the void. Nearly all frontiers result from the combination of unexplored aspects of several previous frontiers. The primary frontier of the California Gold Rush for example would not have been possible if not for at least three previous frontiers. The Beaver pelt frontier of the 1820s and 1830s established routes through the Sierra Nevada Mountains and established an American presence in California. The Oregon agrarian frontier in the 1840s put a wagon road across the continent and firmly placed the idea of Manifest Destiny in the minds of Americans - that America was destined to reach from Atlantic to Pacific shores. The Georgiand gold rush of the early 1800s taught men the skills and developed the technologies of gold mining. Together these three frontiers raised the base of the Launch Bar so that middle-class, and even poor men and women, had the means to take part in the California Gold Rush.

While much of the hardware on the space frontier has directly evolved out of governmental programs, the current economic activity in space is as much or more the result of other previous technical frontiers that have created the equipment and, more importantly, the markets that make the frontier economically viable. Television, which exploded onto the scene in the late 1950s and early 1960s, is the direct parent of the space industry. Earlier communications frontiers stretching back to radio, telephone and even the modern version of telegraph messaging have played a role in creating the markets and technology of the current space frontier. Computers, both mainframe and personal, are also lending heat to the frontier fire. Telecommunications, GPS and Remote Sensing are generating revenue that is in turn being used to evolve transportation systems.

**Conclusion:** Significant advances in Technology, Legislation and Charisma must occur before the Launch Bar for Space-based mineral extraction becomes viable. Other space-related activities such as the International Space Station, robotic exploration and increase in the size of the world economy will raise the base of the Launch Bar. Because of frontier uncertainty, it is very difficult to predict when the Launch Bar will be shortened to the point an attempt at sparking a frontier can be made. Understanding the ramifications of Launch Bars may provide a tool for understanding when the time for such an attempt has arrived.