



## THE HISTORY OF PAST EMPIRES IN THE LIGHT CAPTURED BY MINERALS

“I brought it to about a glimmering light, bringing it to bed with me and holding it a good while to a warm part of my naked body”. This is one of the comments of the scientist Robert Boyle as he described one of the first observations of luminescence. It is a phenomenon that describes the ability of certain minerals to trap energy from its surroundings and subsequently releasing this energy in the form of light. The released luminescence shines briefly and dim, but what does it tell us?

Luminescence dating is a method used to date the last time a mineral was exposed to light or heat and subsequently buried. Each sediment grain tells its own marvelous story of how it traveled through deserts, mountain ranges, rivers, glaciers. How it witnessed the rise and fall of kings, empires, and civilizations. Most importantly it tells us when this happened. You can imagine a grain as the battery of your phone: during burial the grain is “charged” by natural radiation of the surrounding environment but, as soon as it is stimulated by light or heated, the charge begins to be depleted in the form of light. If we can calculate how much charge was accumulated during burial by observing the light the grain is emitting and simply dividing it by the rate of charge per year, we can determine the age. This is a very delicate operation since minerals, as phones, are different from each other: it is therefore important to classify them into the proper types using chemical and physical procedures. Luminescence dating is applicable to sediments, pottery, and heated sediments like bricks to name a few.

My research focuses on the archaeologically rich Orkhon Valley in Mongolia which was the home to multiple successive nomadic cultures which from prehistoric origins, evolved in harmony with

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the natural landscape of the steppes: for centuries the scenario for the major political, trade, cultural and religious activities. The reign over the Orkhon Valley legitimated the rule over all nomadic people as being the center of the world. The numerous ancient cities and burial grounds, situated there, include several nomadic imperial cities such as “Luu khot” by the Xiongnu (1st BC), Karabalgasun (745-840 AD) by the Uighurs and Karakorum (1220-1380 AD) by the Mongols. Samples will be taken from these sites and prepared in a dimly lit laboratory, their luminescence will be measured and the age will be interpreted.

When we think of a nomadic people, we don't naturally associate them with settling down in a large urban settlement. So what drove them to change their pastoral lifestyle for a new urban one? One of the main things to consider when looking at a large settlement is if we can date which constructions were built first. And this is when the luminescence can give us food for thought. Was it the religious temple? The central municipality that served as a distribution center for the imperial administration? This would give insight to what the priorities were in settling down. Another interesting consideration, while applying this method, is if they destroyed a previous settlement and rebuilt their city on its foundation, or grave robbers looted a tomb. If we assume that some of the grains have lost their charge and some have retained theirs, two distinct age groups could potentially be dated and a narrative can be formed. In a way the greatest weakness of luminescence dating (being exposed to light) can work to your advantage. This is a double-edged sword as finding concrete evidence of such events requires more measurements and statistical analysis but the reward is greater.

So what can a brief dim light show us? The burial time of a grain, with this information we can piece together the history of empires.