What is the source of Marfa Lights?

Discussion by James Bunnell

Abstract: Characteristics of Marfa Lights (MLs) are discussed. A hypothesis is proposed that best fits observed characteristics. It is speculated that MLs may be hot plasma bubbles generated deep underground by stress induced electromagnetic anomalies or hot magma. Plasma bubbles rise to the surface through fault zones. In the atmosphere they are constrained by associated magnetic fields. These bubbles are not light emitting, but temperature transfer results in state changes to hot gas at the bubble's surface. Hydrogen converts to hot gas above its autoignition temperature and combines with atmospheric oxygen in a chemical reaction that is light emitting. The conversion from plasma to gas continues until all plasma has converted and burned.

1.0 ML Characteristics

1.1 **Seen in many locations worldwide but appearances are infrequent --** Infrequency of occurrence is the principal obstacle to gaining a more complete understanding of their true nature.

1.2 **Colors are typically yellow-orange or red but other colors, including white, green, and blue, do sometimes occur --** Mixed colors with a white center, yellow surround and then orange to red also occur and are suggestive of a temperature gradient with the center white color being the hottest, and then descending temperatures moving away from the center as represented by yellow, orange and finally red.

1.3 **MLs turn "On" and "Off" repeatedly even when traveling. Off-states when traveling leave gaps in their light tracks (**Fig. 30, 37 and 38 in Hunting Marfa Lights book (Bunnell, 2009)**)–** When traveling MLs turn back "On" following a gap, they are in perfect alignment both geographically and with respect to time, suggesting that something unseen is moving through gaps in the light track.

1.4 **MLs can hover stationary at low altitude (below background mesas), move cross-country horizontal to the ground at low altitude (below back ground mesas) or fly high in the sky above the horizon. The high fliers typically exhibit both vertical and horizontal movements –** Some MLs are stationary at first and then start moving. Travel direction can vary but are typically from southeast to northwest.

1.5 **MLs sometimes eject one or more smaller lights (**Figs. 49 & 52, Bunnell, 2009**). Ejected lights sometimes orbit their parent light (**Fig. 35, Bunnell, 2009**) and sometimes appear to spiral around magnetic field lines (**Fig. 34, Bunnell, 2009**) –** Ejected lights may subsequently go out or else merge back into their parent.

1.6 **Magnified ML images show evidence of explosive-like expansions (**Figs. 30, 31, 32, & 37, Bunnell, 2009**) as well as evidence of falling material as energy decays (**Figs. 35 & 37, Bunnell, 2009**) –** All of these images appear to show evidence of mass and momentum suggesting presence of chemical reactions.

1.7 **MLs resist wind currents; stationary MLs do not "bob" in wind gusts and traveling MLs move in directions not dictated by wind currents –** The ability of these "flying" objects to resist wind currents suggests that they are being responsive to magnetic fields and, therefore, must include charged particles.

1.8 **MLs can occur any time of the night, any season of the year and any month of the year –** Although some months seem to be better than others, sample sizes are too small to draw any conclusions regarding months. MLs can occur anytime of the night but are more likely during the first four hours after sunset (Bunnell, 2009).

1.9 **No correlation has been found to solar activity (**Science Paper SP4, this website).

1.10 **ML appearances do not relate to weather conditions** (Science Paper SP5, this website).

1.11 **MLs are statistically 2.5 times more likely to appear in the second half of the lunar cycle when the sum of moon and sun differential gravity effects are**

increasing back to the maximum that occurs at the time of New Moon – (Science Paper SP1, this website).

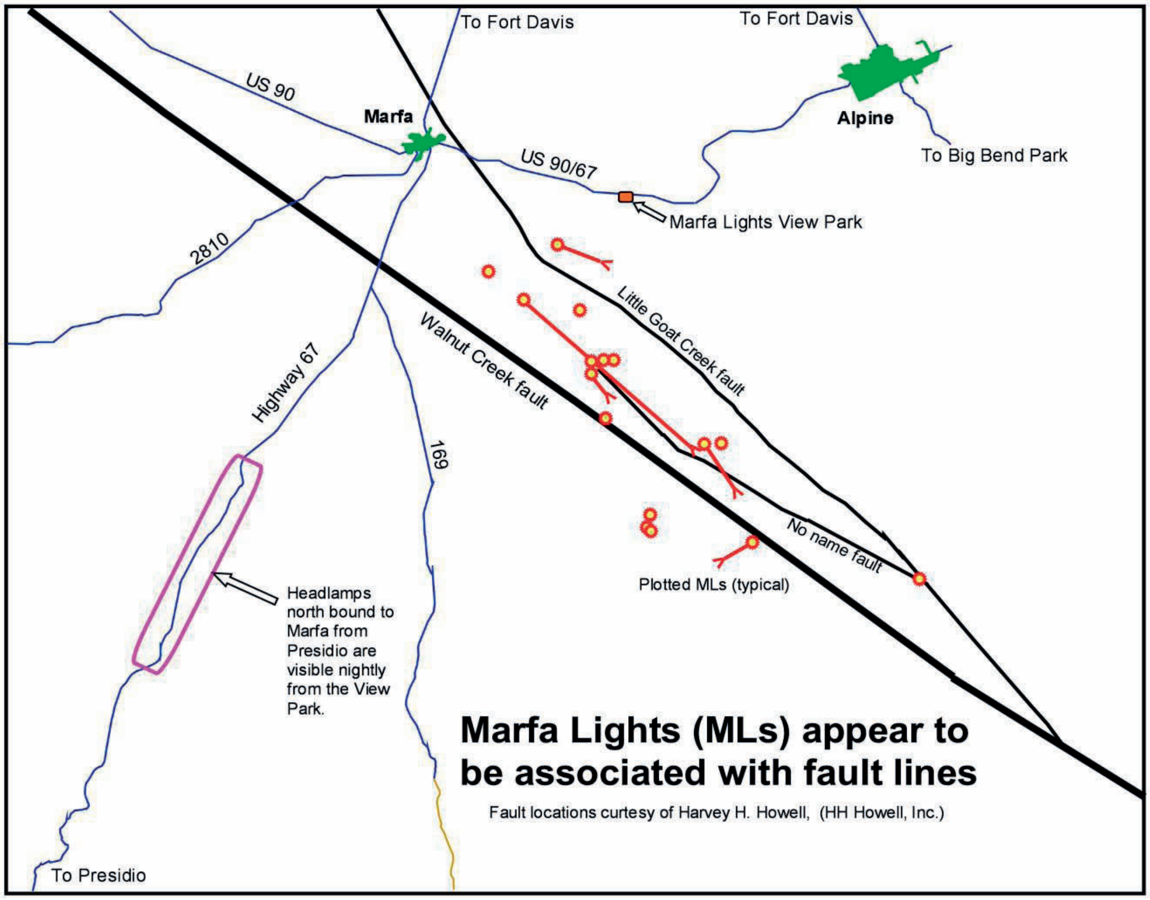
1.12 MLs are nocturnal – Even though MLs are as bright as car lights and sometimes as bright as train lights, they are not seen during daylight hours. What might account for this strong preference for nighttime?

1.13 ML sizes are mostly reported to be similar in size to grapefruit or soccer balls (Bunnell, 2009**), but at least one was extremely large and bright (**Figs. 45 & 46**) –** Energy of this large event was calculated to be on the order or 10,000 watts of visible wave-length power (Science Paper SP2, this website).

1.14 MLs are silent – However, suspect that sounds of chemical combustion might be detected if observers were close enough.

1.15 ML durations vary – Median event times are 4 minutes but 10% last in excess of 40 minutes (Fig. B4, Bunnell, 2009).

1.16 ML locations vary between events but appear to be associated with fault lines in Mitchell Flat based on triangulation and estimation of locations for 17 MLs as shown in the following figure:



Direction of travel, as shown in the above figure, tends to follow fault line orientation.

2.0 Frequency of Occurrence and ML types

Results of long-term studies suggest that most reported Marfa Lights are due to explainable light sources. It is estimated that mysterious lights appear on only about three percent (3%) of nights and are comprised of two basic types, Fata Morgana night mirages and chemical-electromagnetic illuminations (based on the fact that they exhibit both chemical and charged particle characteristics) of unknown origins as summarized in the following table updated from the **Hunting Marfa Lights** book.

Categories	Sources of Marfa Lights	Est. Freq.
“MLs” from Explainable Light Sources	Vehicle headlights Ranch Lights Stars Iridium Satellites Low flying aircraft Sprites (a type of lightning) Lightning Fireworks Train Lights USAF radar blimp Lightning bugs Brush fires and trash fires Oil fires Hoax lights Lights associated with work activity at night	~ 97%
MLs from Unexplained and/or Mysterious Light Sources	Type M (Mirages) <0.5% Type CE (Chemical-Electromagnetic) ~ 2 to 3 % Subtype I – tiny specs of light Subtype II – stationary Subtype III – move x-country Subtype IV – above horizon	~ 3%

3.0 Theory

Some MLs do indeed exhibit characteristics of Night Mirages. Fata Morgana mirages are understood phenomena and readers with an interest are referred to the prior page on **Night Mirages,** this website.

The following discussion is focused on unexplained MLs that exhibit chemical-electromagnetic (CE) properties.

- **Evidence for chemical combustion** (characteristic 1.6 above plus the fact that spectra are usually continuous).
- **Evidence for electromagnetic involvement** (characteristic 1.7 above plus their ability to fly at low altitudes (characteristic 1.4) and to eject off-spring that orbit the parent and sometimes appear to spiral around magnetic field lines (characteristic 1.5)).

Logical questions anyone might reasonably ask are, “Why should MLs appear in Mitchell Flat east of Marfa? Is there something about this particular location that is geographically unique?” It turns out that this location is indeed unique in ways that may be relevant to appearance of MLs. Mitchell Flat lies in the “Marathon Uplift” region of the “Quachita Overthrust” which is to say that it is a location where two tectonic plates are jamming together. The northern plate is being subducked under the southern, uplifted, plate. This Quachita plate boundary extends out of Mexico, right through Texas, into Oklahoma, Arkansas, Mississippi, and on through Alabama, and Tennessee where it is referred to as “Appalachian Thrusts.” Interestingly enough, significant oil and gas discoveries lie all along this plate boundary.

Chinati Mountain located southwest of Mitchell Flat is an ancient volcano that, around 35 million years ago, spewed enormous amounts of volcanic ash completely covering Mitchell Flat. Paisano Mountain located northeast of Mitchell Flat is another, even closer, ancient volcano that also spewed volcanic ash to cover Mitchell Flat millions of years ago.

Tectonic plates in collision create tremendous forces and this plate boundary may well be the ultimate energy source for MLs. The presence of nearby volcanos means that hot magma may exist not too far below the surface. This suspicion is reinforced by observation of occasional venting (Figs. 63 & 64, Bunnell, 2009). The nature of this venting is unknown.

Tectonic stress can be significant in another way as demonstrated in laboratory experiments by NASA scientist, Dr. Friedemann Freund (Freund, 2009). Dr. Freund has shown that igneous rocks start to behave like batteries when subjected to sufficient stress. This is a significant discovery because tectonic stress can produce extreme current anomalies that may drive available gaseous elements into a plasma state.

Given complexities of Marfa Lights and their observed characteristics, I suspect they may fundamentally be plasma bubbles generated deep underground, either by a Freund electromagnetic anomaly, or else by hot magma. Plasma is a fourth state of matter. We are all familiar with three states of matter, solid, liquid, and gas. Plasma is a fourth state of matter in which a portion, or all, of the particles are ionized. Heat gas molecules enough and molecular structure breaks down resulting in atoms with more or fewer electrons (i.e., charged particles; both positive and negative ions). Partial ionization might be caused deep underground when some available gas (e.g., hydrocarbons, salt, steam, etc.) is heated sufficiently by hot magma or else ionization may be induced by a strong electromagnetic field generated deep underground by igneous rocks subjected to tectonic stress of this colliding plate system (Freund, 2009).

Like gas, plasma has no definite shape or volume but, unlike gas, plasma is very responsive to magnetic fields and that may explain the ability of MLs to resist wind currents as well as other characteristic behaviors including splitting, orbiting, spiraling, and horizontal flight at low altitudes. Plasma behavior is extraordinarily varied and subtle (Wikipedia on Plasma), a fact that fits well with MLs wide variety of behaviors.

Likelihood that MLs are fundamentally plasma (given their complex behaviors) must be balanced against photographic evidence of mass, momentum, and continuous spectral patterns that point to chemical combustion. This may have to do with the degree of ionization. Even gas with as little as 1% ionization can exhibit characteristics of plasma (Wikipedia on Plasma). I speculate that ML bubbles generated deep underground by an electromagnetic anomaly, or hot magma, rise up through fault zones highly ionized. After emerging into the atmosphere, heat transfer into cold night air causes atoms to drop out of their plasma state along the bubble's surface. Hydrogen atoms returning to a gas state above their autoignition temperature (500 degrees C), immediately combust grabbing atmospheric oxygen to form water molecules. The resultant flame front slows heat transfer helping to preserve ionization within the core bubble. It is this chemical burning along the bubble's surface that produces visible light we see and call Marfa Lights.

- **Why are ML spectra usually continuous?** Because surface level flame fronts are chemical fires and those fires usually mask an underlying ionized core.
- **Why are MLs nocturnal?** Because elongation of the magnetosphere on the night side aids release of ionized bubbles.
- **What accounts for gaps in ML light tracks?** Gaps occur when available hydrogen fuel is expended because the core plasma bubble is not light emitting. When the surface fire goes out, heat transfer accelerates and hydrogen combustion resumes thus accounting for the "On – Off" common characteristic of ML displays.
- **How are MLs able to resist wind currents?** Ionization of the core bubble is highly responsive to magnetic fields (and those fields may be generated by the same electromagnetic anomaly that created the plasma bubble).
- **What accounts for the wide variety in observed ML behavior and locations?** Degree of ionization and mix of elements in the core bubble.

4.0 References

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