

## McCoy, Mike

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**From:** Kim Cantin  
**Sent:** Saturday, August 7, 2021 1:19 PM  
**To:** Linver, Sol  
**Cc:** Danielle K  
**Subject:** Fwd: Assessment of Marshall University Forensic DNA Lab

Hi Sol,

Sharing the below detail from the Professor on carbon dating to expand on her expertise with it and an updated report from them that discusses the UCSB analysis.

best,

Kim

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**From:** Danielle K >  
**Date:** Sat, Aug 7, 2021 at 11:46 AM  
**Subject:** Re: Assessment of Marshall University Forensic DNA Lab  
**To:** Kim Cantin <>

Hi Kim,

Just to follow up: Yes, Undersheriff Linver is correct that radiocarbon (C-14) dating is not the optimal approach for remains which may be less than about 70 years old.

If I may, please allow me to further expand on the excellent points the Undersheriff has rightly brought up:

1. Half-Life. C-14 has a short half-life -- about 5700 +/- 30 years. So, once an organism dies, it will lose half of its c-14 particles every ~5700 years. This is great for things that are hundreds of years old to about 55,000 years old, but not great for recent things. So, an organism that died in 2018 has only lost 0.00053% of its C-14--our instrumentation is not yet at a level to determine things on such a fine-grained scale
2. Degraded sample. C-14 is extracted from bone collagen--the organic part of bone that also yields DNA. The degraded, brittle & friable quality of the bones suggests the collagen was leached out of the bone by the very acidic soil. You may not get results if there is no collagen left in the bone (and DNA techniques are orders of magnitude more sensitive than 'clunky' carbon-14 analysis). We used [fluorine dating because](#) it uses the inorganic (mineral) component of bone, and not the organic (collagen) component of bone. While, admittedly, an absence of evidence is not evidence of absence, our null (zero) reading of fluorine absorption in the bone mineral suggest the bones have not been in the ground very long (years-to-decades vs. centuries-to-millenia). We can retest, if you'd like.
3. Calibration & Error Ranges. Right now, the best C-14 dates still have an error rate of +/- 30 years (60-year range), and sometimes, if you have a dynamic area of the calibration curve, the number of samples, and the application of Bayesian stats (eg, [OxCal](#)), you can get to +/- 15 years (so a range of 30-60 years), but still not quite what we need to identify someone who died only a few years ago

4. Testing isn't confirmatory. You won't get a date that says ("Jan 2018") that could confirm it was Jack to the exclusion of anyone else. You will either get an ancient bones (contradicting our fluorine testing), or a null result because its too recent

5. In C-14 dating, we use the term "XYZ years *before present*" but the "present" refers to when the technology was invented--- in 1950. While the calibration curve was updated in 2013--[and is due for another upgrade](#), until this happens, anything more recent than 2013 is pretty much impossible to analyze accurately or precisely.

6. Climate change and Atom Bombs -- we can calibrate our C-14 dates with other confirmatory tests. A big one in the USA is using [dendrochronology](#) (aka tree ring dating), to get c-14 dates and calendar years to "match up." However, the dropping of the atom bombs since the mid 1940s have screwed up things a bit (similar in the way all rocks all over earth show a layer of iridium (an outer-space metal) that was deposited when the dinosaur-killing comet hit our planet 65 mln yrs ago). More problematic, and relevant to this case, however, is the climate changes that have occurred since ~1970. Our calibration curve (how we match-up the amount of c-14 left in bone and a calendar year) is based on the amount of C-12,-13, and -14 in our environment (called "the carbon cycle"). Global warming and environmental degradation (and disasters) are occurring bc the carbon cycle is increasingly out of whack (thing 'global warming' coral bleaching, desertification, etc.).

A note on laboratories:

Miami's [Beta Analytic](#) is one of the top commercial labs in the country. I have used their services and have been pleased with the results---I've sent the same sample to both Beta & [UC Irvine's Lab](#), and the dates match up really well. Both use Accelerator Mass Spectrometry, which allows for smaller samples to be used (e.g., 5 grams of good intact cortical bone vs 40 grams). Beta is relatively expensive, but that is largely related to service costs and their very quick turnaround time (from days to weeks, depending on the type of sample submitted).

Finally:

You asked me to make some revisions to the Final Report: specifically, to include *only* the dispositive results from our (UCSB) work. I have attached a copy with those revisions

I hope this information aids in your decision-making process.

Regards,  
DSK

On Sat, Aug 7, 2021 at 10:40 AM Linver, Sol <[sml0409@sbsheriff.org](mailto:sml0409@sbsheriff.org)> wrote:

Understood. I will have our staff contact the labs noted.

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**From:** Kim Cantin <>  
**Sent:** Saturday, August 7, 2021 10:31:18 AM  
**To:** Linver, Sol <[sml0409@sbsheriff.org](mailto:sml0409@sbsheriff.org)>  
**Cc:** Danielle K <>  
**Subject:** Fwd: Assessment of Marshall University Forensic DNA Lab

Dear Sol,

I hope you are well. Thanks for calling me yesterday with the update and your suggested options; I really appreciated the update.

As we discussed, I ran the options past the UCSB Professor to get her thoughts on the lab. **Below are her comments.** After I read the comments, I'm not comfortable with a lab with these qualifications, but I would be more comfortable

with Harvard, or UCSC that she mentions. I just am hesitant to destroy my son's remains that I have been hoping for over 3 years and I know you can appreciate that. If more DNA effort is done on the bone, it's imperative that a top-tier PhD level research lab is engaged, so that I have confidence in the expertise and technology to be expended in the effort.

Also, the Professor agrees with your thought about the carbon dating option; it too is her least favorite. She thought about that and can send specific details and as she explained it to me, that approach will not tell Jack's age which I think you need as confirmatory (Danielle- please set me straight if I am not articulating your thoughts correctly). We know from UCSB's report that flourine levels assessed on the bones have proven they are not ancient.

Again, below is her specific detail on the Marshall lab. Thank you so much and please call me or the professor with any clarifying questions or thoughts.

Thank you!

Kim Cantin

----- Forwarded message -----

From: **Danielle K** <>

Date: Fri, Aug 6, 2021 at 11:31 PM

Subject: Assessment of Marshall University Forensic DNA Lab

To: Kim Cantin <>

Hi Kim,

You requested my assessment of the [Marshall University Forensic DNA Program](#).

I reviewed materials available on the MU Forensic Science website, although the page on Forensic DNA Analysis, specifically, is a [dead link](#). The lab is a service-oriented lab (vs. research & development) that apparently runs samples for local, state and federal cases. The program seems like a solid forensic science MA program, but I do have some concerns of using MU as a "lab of last resort":

1. MU is not an R1 /PhD granting program, only masters programs (with rolling admissions). In the DNA lab, it is those Master's students who I assume run the samples. These students only have to take 3 courses to become a DNA tech. The courses they have to take are the same that we teach our undergraduate BA/BS students. Unfortunately, it appears that biostatistics and other crucial concomitant techniques are not taught in MU's Forensic Lab. The math has to go hand-in-hand with the methods when dealing with degraded bone. It's much more difficult than running a fresh rape kit or paternity test.
2. Hard to find and SOP's or any information on reagents being used, what sort of instrumentation is used, etc. It is impossible to assess, verify, and replicate results when the methodologies are not transparent, and when the practitioners have not vetted their advances through peer-review.
3. DNA Lab is run by a professor who has MS in Forensic science from Marshall University (vs. a PhD). I cannot find any publications or PI-grant work by this individual, and I have not been able to find a CV during my cursory search of google scholar, researchgate, and [academia.edu](#).

4. MU's Forensics program is run by a PhD--but in education (vs. some hard science). This director does have an MS in forensic science (microscopy) from Marshall University. I cannot find a CV or any peer reviewed publications or PI-grant work by this individual during my cursory search of google scholar, researchgate, and [academia.edu](http://academia.edu)

Should you decide to subject the bone samples for nDNA analysis, instead of Marshall University, I would recommend working with one of the three best labs in the USA: [The Reich Lab at Harvard](#), the [UC Santa Cruz PaleoGenomics Lab](#), or the [University of North Texas Center for Human Identification](#).

Full Disclosure: the Peruvian Ministry of Culture allows me to export 1000-year-old bones for ancient DNA analysis so long as I run those samples at Harvard &/or UCSC --(they've been sitting in cold storage for ~4 years now, still in the queue and slated for extraction this fall/winter, followed by biostatistical results over the next year)

Quality takes time (sometimes months or years, unfortunately), and there's a huge back-log. So be forewarned that although working with the above labs are more likely to be able to assess degraded bone fragments for DNA, those answers will take a long time.

Every option has pros and cons---I hope this information helps you make an informed decision.

Regards,  
DSK

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*A man is worked upon by what he works on. He may carve out his circumstances, but his circumstances will carve him out as well*

--Frederick Douglass

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