This summer I have investigated the fault slip history of the Ama Drime Range by using the
geochronologic code Pecube to model fault activity through time. In other words, I am using a
numerical modeling code to constrain the timing and duration of faulting activity in the Ama
Drime. Faults are fractures in the Earth’s crust and active faults can bring up material from great
deptths to the surface over time. The data we collect from this material allows us to understand
the cooling history of that region by assuming a geothermal gradient and understanding the
geologic features surrounding the fault. Our field site is located in Tibet, China near the boarders
of West Bhutan and Nepal (Fig. 1). We
have evidence that this region
sustained uplift along two normal
faults ~ 12-15 million years ago (Ma)
and again about 15,000 years ago. We
cannot know for certain what happened
between this elapsed time spanning
millions of years. A few possibilities
include the faults slipping fast and
slowing down over time; they could
have started slowly to slip, increased to
a fast rate and then decreased again; or,
there may have even been a period of
inactivity. Due to limited data,
previous researchers concluded the faults have slipped at a continuous rate through time since
their initiation 12-15 Ma. While this idea is plausible, new data gives evidence for a more
complex history of the Ama Drime Range. These new data spur the investigation of my research
this summer: to explore the geologic scenarios most possible to our data by modeling this region.

The first part of the summer I spent most of my time learning about our data, my field site and
Pecube. Once we could acquire the code, I set up Pecube and learned how to navigate its
directories. The version we downloaded included an example problem from West Bhutan, an area near our field site; most of my coding work concerned alterations to previously existing files from this example. Our data was collected by Dr. McDermott from a field season in 2012 (Table 2). Thermochronologic data is obtained by analyzing mineral grains for the concentration of parent and daughter isotopes and referring these concentrations to a depth at which the mineral became a closed system to trap the daughter product. These calculations give a cooling age of that mineral that helps us understand how quickly that grain came to the surface and how long ago it was at depth. I uploaded and formatted data from the Ama Drime along with a Digital Elevation Model (DEM) of our field site to give topographic information. There are also two parameter files which I modified from the example problem: topographic and fault parameters. I chiefly focused on choosing value ranges that make sense for the region’s geology.

Among the challenges of using a model to better understand Earth, it is very possible that results from the model do not correlate well to Earth processes. This provided the background for me to set parameter values that allow for geologic changes possible to the data.

Our goal is to investigate the fault slip history of the Ama Drime range and hopefully gain evidence for possible geologic scenarios. Modeling allows for computations and evaluations across various geologic scenarios which encourages the user to consider more possibilities with less computing time. My goal this summer was to learn how to use Pecube and run the model using our data. I then hoped to run inversions of the forward model runs, a second stage of Pecube that attempts to converge two datasets in order to choose the best range of input parameters (Braun et al., 2003). In addition to running iterations of the model, I would continue to complicate the geologic possibilities; I would start with no faults, then only one fault and progressively add more faults with varying activity with each model run. I hoped that by the end of the summer I could have some sort of output or result from these Pecube runs to investigate

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<th>Sample number</th>
<th>Method (U-Th)/He</th>
<th>Mineral</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation depth</th>
<th>Date (Ma)</th>
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Table 2: Thermochronologic data (U-Th)/He in zircon.
what scenarios Pecube chose that best fit our data. A larger goal for this summer was to use my results from Pecube as evidence to support hypotheses of fault activity in the Ama Drime in a previously written manuscript by Dr. McDermott that would be submitted for publication.

I did not achieve all the goals I set for myself this summer. I so far have not been able to run a forward model of Pecube with no faults without encountering an error. Most of my work after downloading the code has been diagnosing an error and problem solving how to fix it. Often, once an error was fixed, a different problem presented itself that required attention before being able to run the code again. I hope to continue this project either in the fall or next summer. Ultimately, I hope to complicate the geologic scenario by adding multiple faults maybe with various activity. This would allow us to compare Pecube’s results from a simple scenario, such as a continuous slip of one fault, against a very complex one. The future of this research entails not only running Pecube to compare results, but also extracting evidence to support a hypothesis concerning past events in this area. The results of the model runs will only be helpful when applied to the region of interest and drawing conclusions within the context of a background of the geology of the Ama Drime. While we hope Pecube will primarily show what situations most likely occurred, the results may also sort out events not possible to our data. If the results of Pecube point towards (a) particular event(s) I will inquire how this/these occurred and seek to understand the circumstances of the event(s). On the other hand, if our results disprove more than highlight specific events, then I hope to investigate and narrow down the most possible outcomes. I hope nonetheless to run various geologic scenarios using Pecube to consider a broad range of possibilities.
Bibliography


