Animating Earth History:
Plusses and Pitfalls in Creating/Using Educational Geo-animations

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I come to animation as a geo-science content provider; as an academic research scientist and teacher with a background in marine geophysics and plate tectonics. I lecture about plate tectonics in a great number of venues to a great range of audiences: university courses at all levels, national and local professional meetings, museum/naturalist groups, media groups, retirement homes, after-dinner for community organizations, etc, and, especially, lots of K-12 teacher development workshops. Plate tectonics is a profoundly visual subject, so every presentation I give is full of images: maps, landscape photos, graphs, and conceptual diagrams. I started animating out of pure frustration because plate tectonic stories are always four dimensional. I really needed my images to move and change with time. I was wearing out my arms, waving them in the air – trying to sketch out the mental animations that I had running in my head.

I started animating in the 1980s with the production of a twenty minute intro film, "Continental Drift and Plate Tectonics". We made it with student artists and student shooters painting stacks of Disney-style plastic cels and shooting them: thirty frames per second, one frame at a time! Despite its drawbacks of this old film - very amateurish production, some important content mistakes (editing was nearly impossible with so many painted cels) - it is still used extensively in classrooms around the world and at many levels. I learned some lessons from this project. 1) The teaching world is hungry for clear, concise explanatory visual materials. 2) One set of simple, clear, moving images can communicate ideas across a surprisingly large span of cultures, ages, and knowledge levels; we were aiming at large freshman "intro" classes, but in fact the movie is used from graduate classes* to fifth grade**, and it is used by non-English speakers (with the sound turned off and the teacher narrating as needed).
The advent of user-friendly computer-animation programs in the 1990's made me into an animation fanatic and the development of web-delivery opened a huge new set of opportunities. My recent passion has been to create basic geological information packages on local and regional scales and offer them to anyone who will use them.

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* as a quick introduction to get everyone onto the "same page".
** as a "capstone"-like experience to cement in what they have been studying.

The local aspect is crucial for the teaching of introductory geology since each locality has its own distinct, smallish subset of geological objects and processes, rendering much of the material in any textbook unfamiliar, alien and, some would say, irrelevant, at least for that important first taste.

Since there is no way that I can personally master the local/regional geological stories of more than a few places, I have set up a visitor's center (EMVC or Educational Multimedia Visualization Center). Colleagues are invited to visit, bringing their regional expertise and still images and leaving with animations and digital imagery. Thanks to an

NSF Distinguished Teaching Scholars Award, the center offers the services of a geo-artist, student animators, video and sound studios, dissemination possibilities, and good geological conversation; visitors' travel and living expenses are paid. For more information about the center and/or to download some of our products, visit our website at http://emvc.geol.ucsb.edu

Below is a listing of insights and problems that I hope to share and discuss at the meeting.

Some factors affecting effective communication using conceptual animations:

- Medium to fast moving objects get the attention, hence the particular importance of ones choices for frames of reference and movie speeds.
- Very slow motions or changes are invisible. (It is shockingly easy for the animator to cheat.).
- Clutter is bad. Simple, cartoon-like images work best for getting concepts across,. but you can include more sophisticated information if it is properly toned down (partially mollifying us scientists' anal need for "accuracy").
- Animations are most powerful when imbedded among still landscape/data images (i.e., "Here is what we see" [best if it is a familiar object] "and here is how we think it came to be".) and when used as a complement to hands on activities and field trips.
- In presentation, an animation needs to be repeated several times, preferably with the presenter suggesting different aspects to watch on each repetition. (After a single run-through, the viewers are often in a panic).
- Settings where the viewer can control the repeats, stops, goes, frontward, backward, etc., are especially engaging and instructive, when they are included as parts of lab exercises, for example.
- Moving images aren't a priori better than still ones. (For example, I don't think most fly-throughs convey information very well, though they do add a fun-factor.)
- Creation of an animation always takes at least three drafts (like any serious figure or text). We are always surprised when we get the first draft up and running.
- Viewers tend to attribute more authenticity to cartoons and animations than the makers intended. (Especially when the animation/cartoon was successful at teaching the concepts. Scary!)

Some technical problems that I'd like to hear about from anyone who is doing these things:

- Transfer of computer and photographic images to VHS videotape = ugly and sad! (And, for now, it is the only way to supply materials to many schools. Hopefully this will solve itself some day soon.) Reds run, colored vertical lines turn black, edges blur, details crawl, edges are cropped.
- Delivery of movies over the web. What works? Is streaming a realistic alternative to big downloads? What works for low end users?
- Delivery of power-point conglomerations via the web. Narrated or not? Does written narration work? Other power point issues for telling a story.
- Other ways to deliver mixes of imagery, animation, and narration/text.