

"I've Seen the Miocene" in Central Oregon

By Ted Fremd

Within what is now the beautiful John Day River Basin in central Eastern Oregon, thousands of feet of sediments were deposited over hundreds of square miles during tens of millions of years. These strata represent a bewildering variety of processes and events that left practically every category of sedimentary and volcanic rock type, from tremendously violent pyroclastic surges to the gentle accumulation of fine-grained ash in lake environments.

Presently, fossiliferous exposures of these rocks total tens of thousands of acres: much more was either eroded away during subsequent tectonic episodes or is currently buried under thousands of feet of basaltic lava. In a few areas, such as within the John Day Fossil Beds National Monument (JODA) boundaries, significant segments of the stratigraphic column are exposed, revealing some of the finest Tertiary plant and vertebrate assemblages in the world.

The world renowned significance of the John Day Basin is due to a fortuitous combination of five factors:

1. Because of continual volcanoclastic deposition, large numbers of very well to excellently preserved paleontological specimens are available, both in the field and in repositories.

2. The taxonomic diversity of these faunal and floral assemblages is high, sampling a broad spectrum of the ancient ecosystems.

3. The fossiliferous strata span a long time interval with few temporal unconformities.

4. This sequence of entombed biotas was accumulated during significant time intervals in earth history, including periods of major climatic changes, adaptive radiations, and mass extinctions.

5. A variety of dateable marker beds (crystal-rich "tuffs") conveniently permit ready correlation of the strata, both within the depositional reservoir and with those documented from elsewhere on the planet.

The temporal range of strata exposed in the John Day Basin is impressive (Table 1). Although there are many hiatuses of varying lengths, it is remarkable to have such abundant, varied, and well-preserved fossil populations enduring in one geographic area. In most areas on the continent, geologists are required to "cut and paste" stratigraphic sections that may be quite remote from one another – a process that considerably lessens the accuracy of results. Comparison of the JODA fossil populations with those recovered from sediments of similar age throughout the world is yielding important models of terrestrial floral adaptation and mammalian evolution.

A Little Research History

The analysis of fossils from the John Day Basin began roughly 120 years ago and continues with gusto today. The history of fossil retrieval before establishment of the national monument reflects a small-scale and temporally compressed version of the larger history of western North American paleontology. For example, early activity (ca. 1870s) consisted predominately of "trophy hunting," often by hired collectors. Crates of specimens were shipped to the sponsoring eastern institutions, with

locality data that can be designated generously as "vague." If the fossils differed substantially from previously described specimens, they were tagged as new taxa (the differing views of "substantial" contributing in large measure to the development of modern paleontological systematics). The majority of type specimens were collected sloppily early in this purely descriptive (and sometimes pugna-ciously argumentative) phase of paleontologic research, resulting in a plethora of taxonomic synonyms and vaporous localities that still plague the researcher.

In the following decades, workers began to look more thoroughly at the encapsulating rocks and stratigraphic units themselves, subdividing the formations into recognizable members and horizons. Comparisons of these were made with previously described localities of similar geologic age, and work began constructing stratigraphic and biotic correlations of dozens of beds in the John Day area with those from elsewhere.

Most recently, the monument has been supporting studies in absolute age determinations, using single crystal laser fusion technology and magnetostratigraphy. Other investigators, collaborating with the monument's museum staff, are focused on paleoecological syntheses of paleosols and fossil units, gradual evolutionary change, biostratigraphy, taphonomy, and other projects.

Research Benefits

Interpretation and public enjoyment is enhanced as a result of this research process as well as its results. The pursuit of this knowledge can itself be interpreted in the parks, perhaps better than anywhere, because the parks are the actual *places of discovery* – the laboratories of geologic inquiry. Accurate interpretation of the science of paleontology in the midst of active exploration and excavation is important. It beats merely explaining how this process might have been done, or describing how this is happening somewhere else.

It also reflects on the credibility of the Service that the most accurate, up-to-date information pos-

sible is presented to the public and that erroneous or outdated theories are promptly removed from exhibits and programs. This bolsters the public perception of the Service as an active manager, not a passive caretaker. Nearly all scientific research is justifiable on interpretive grounds alone.

Curation and administration of the museum mission benefit from scholarly study. For example, the ability of NPS curators precisely to identify specimens in their care is critical. However, taxonomic studies do not merely identify material for cataloging purposes; they are essential in determining the relative significance of specimens. The ability of curators to determine the scientific value of specimens, both in the field and in the collections, is indispensable. And this value can only be ascertained through scholarly analysis of the literature, reference collections, and time-stratigraphic relationships revealed through research.

Natural Resource Management at the monument is facultatively divided between recent (neontological) and fossil (paleontological) resources, with most emphasis given to the latter. In many "fossil parks," neontologists have held sway. Indeed, it is only within the last two decades that Servicewide paleontological resources have been viewed as threatened objects, or even as a resource to be actively managed at all. Perhaps this is because "rocks" appear not to demand the relatively constant surveillance modern ecosystems need; or because of confused priorities between preservation of weathering processes and preservation of significant specimens; or simply because of a lack of strong advocacy such as that enjoyed by cultural resources.

Complacency may be appropriate in some strata, where fossils are so abundant or durable that there is, in fact, little threat. In most localities, however, deterioration of the resource is measurable. The reader can consult the sections within NPS-77, Paleontological Resources Management, for an overview of the programs currently employed at JODA and other developed sites. The cornerstone of this activity is a program of cyclic prospecting, where scientifically significant specimens are collected with abundant field data, including precise locality records, and placed in dedicated museum storage where they can be preserved and are avail-

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Table 1. Key fossil assemblages of the John Day Basin represented within or proximal to management boundaries of the National Park System. Presented in temporal order, with the oldest strata at the bottom.

FORMATION	ASSEMBLAGE NAME	AGE
RATTLESNAKE	Rattlesnake flora	Pliocene
RATTLESNAKE	Type Rattlesnake fauna	Pliocene
MASCALL	Mascall Flora	Miocene
MASCALL	Type Mascall Fauna	Miocene
PICTURE GORGE	Palynomorphs	Miocene
JOHN DAY	Haystack Mbr. Fauna	Miocene
JOHN DAY	Kimberly Mbr. Fauna	Miocene
JOHN DAY	Turtle Cove Fauna	early Miocene
JOHN DAY	Bridge Creek Flora	late Oligocene
JOHN DAY	Big Basin Fauna	Oligocene
UPPER CLARNO	Fern Leaf, others	Oligocene
UPPER CLARNO	Slanted Leaf Beds	Oligocene
UPPER CLARNO	White Cliffs	Oligocene
UPPER CLARNO	Hancock Mammal Quarry	late Eocene
LOWER CLARNO?	Lahar deposits	Eocene
LOWER CLARNO	Nutbeds Flora	Eocene
LOWER CLARNO	Nutbeds Fauna	Eocene

able for study.

Positive steps have been taken at several monuments, including JODA, to quantify threats and diminish harm to scientifically significant fossils. Obviously, the process of planning and design of park facilities is enhanced by accurate baseline data. Research also improves the ability of the manager to control public use patterns, identifying park areas warranting greater protective measures that range from simple surveillance to formal closures of sensitive areas. A productive cooperative agreement for paleontological resource protection with the Bureau of Land Management in the monument's vicinity was made possible only as a result of detailed research groundwork.

In contrast to the covetous approach that typified early work in the area, JODA and other NPS sites are entering an exhilarating new phase of helping to share research with society. A new visitor center with a major series of exhibits, dedicated museum storage, and lab facilities is being planned with cooperation and enthusiastic input from the research community. The position of NPS as a leader in the management of fossil resources looks brighter than ever before.

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