

Preface

Just over 201 million years ago the Earth was hit by an asteroid.

It struck the area we now call the Limousin region of France, close to the small town of Rochechouart. Today the Rochechouart region is a peaceful and delightful part of France, famous for its beef cattle and Limousin pottery.

In this booklet we take a multi-disciplinary view of the asteroid impact. We look at:

- what France was like at the time of the impact from a geological and topological perspective; what plants and animals were in the area; and the climate of the time;
- the type of asteroid which hit, its probable size and composition, and we consider the effects the strike would have had on the area;
- The timing of the asteroid strike which coincided with a species mass extinction, where globally ~70% of species were eradicated;
- how the impact could have been associated with this devastation of life on Earth.

Finally, we describe and provide a guide to sites of interest where the evidence for the impact can be seen today. The guide is augmented by many more images available in our free-to-access gallery at <http://www.observatoiresolaire.eu/limousin-impact-gallery.html>

The area is a wonderful place to both live and visit, and our aim is to encourage visitors and residents to explore the evidence for one of the most devastating events the planet has seen.

1. Introduction

The Earth has been struck by many asteroids in its 4.6 billion-year history, and it will be hit by asteroids again in the future. Asteroid impacts are one of the most devastating and destructive events for the planet, and are a real threat to humankind's future. Many of the national and international space agencies, especially NASA and ESA, have programmes to quantify the risks and identify practical solutions to mitigate the chances of an impact, and the effect of such strikes.

Perhaps the best known asteroid impact is the Chicxulub, Mexico incident 66 million years ago which presaged the death of the dinosaurs. Much closer, and more accessible, for European investigators is the asteroid impact which hit France at the transition between the Triassic and the Jurassic periods. The impact, close to Rochechouart in Limousin, would have caused very widespread (most of current day France) destruction to fauna and flora and the geological effects remain evidential today.

The event was unknown until the mid-1960s, when geologists examined the unusual nature of rocks in the region. There is no crater today, it has been eroded away completely over the past 200 million years, but we look at the geological footprints that remain. From these we can, coupled with a knowledge of solar system asteroids, make deductions of the type of object which struck.

The region is still actively being studied, both by students and investigators. The CIRIR (Centre for International Research on Impacts and on Rochechouart) has initiated a 2-year programme of drilling bore holes in the region to enhance our knowledge of the scope and scale of the impact.

We will start our review here by considering what France was like at the time of the impact, and by looking at the Earth's history of mass extinctions. After a brief résumé of solar system asteroids we then

survey the evidence available today from the impact. From these we can make deductions about the nature of the impactor, and thus the effects on plant and animal life that would have ensued. We conclude our review with a brief, but practical guide to sites that the interested reader can easily visit in order to make 'real' this ancient catastrophe.



Limousin today;
A very different place to what it was 201 million years ago.

2. France in the Rhaetian age of the Triassic

The world is a very different place, geologically, geographically and climatologically speaking to that of 200 million years ago (mya). The continents were not in the same form or position during the Triassic period and lifeforms, both flora (plants) and fauna (animals) have evolved throughout geological time. Many lifeforms have become extinct over the eons.

As for humans, the earliest evidence of our homo-sapiens direct ancestors dates from around a mere 160,000 years ago. There is some evidence that both Neanderthals (which were a different, but now extinct form of human) and homo-sapiens evolved from a common ancestral species around 500,000 years ago. However, even half a million years is completely insignificant over the 4.6 billion years of the Earth's lifetime.

The geological history of the Earth has been, by human convention, divided up into time segments called eras, periods, epochs and ages. We are currently living in the Quaternary period of the Cenozoic era. The specific time frame we are looking at within this booklet is the Rhaetian age, of the Triassic period, within the Mesozoic era. These various time frames are best seen in a picture, and an overview of the different geological times can be seen in Figure 20 of section 7.1.1

During the Triassic, the Limousin region of France and indeed all of Europe was part of a much larger continent. It was at a lower latitude (around 30° North compared to the present day 45.8°) and thus inherently warmer. The global atmosphere was also warmer than today and the region now known as France would have been much drier than today.

Ferns and palm-like plants would have been the dominant foliage within the Limousin area, although some larger trees such as cedar and conifers would have been seen in more irrigated pockets. Insect

life abounded with dragonflies and mayflies competing with grasshoppers, cicadas and flying beetles.

On the land, small dinosaurs began to establish their soon to be dominance, and the first true mammals arose (in the form of shrew and weasel-like creatures). In the seas, ichthyosaurs ruled and the air was the kingdom of the pterosaurs.

By putting together what we can deduce about the position, climate and flora of France 200 mya we can envisage a semi-arid tropical type region, with very hot summers but cool winters. Today, our best equivalent representation of Limousin in the Rhaetian age is perhaps the inland areas of Morocco, such as in Figure 1



Figure 1 Morocco south of Marrakesh

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