

## **When Continents Collide**

by Ole Hendrickson

Slow-motion video footage of the Ottawa Valley's past would have captured the formation and disappearance of great mountain ranges and ice sheets, accompanied by massive earthquakes and floods, interspersed with long periods of warm, shallow seas.

We have no videos, but thanks to the efforts and research of many scientists we have a pretty clear picture of the Valley's geological history.

Marine bacteria ruled the Earth in the Precambrian over a billion years ago. Precursors of the continents of Africa, Europe, and South America converged on an older and smaller version of North America, creating a supercontinent called Rodinia. Continental plates crashed together and buckled upwards, forming the mighty Grenville Mountains, higher than the Himalayas. Molten rock surged from deep within the earth to fill the spaces beneath the up-thrust plates. Near the epicentre of this great collision a great upsurge of magma slowly cooled into the granite dome of the Algonquin batholith, occupying much of the current area of Algonquin Park and adjacent Renfrew County.

Erosion wore away Rodinia's great mountains and exposed their granitic roots during the next 250 million years. As the thickness and weight of the crust decreased, the remaining nubs of the mountains floated upwards on the heavier underlying molten mantle. During the late Precambrian, 750 million years ago, Rodinia cracked into new continental plates. These pulled apart, leaving bits and pieces stuck onto the North American plate and increasing its size.

During the break-up of the super-continent, North America itself began to split apart in the area now occupied by the Ottawa and St. Lawrence valleys. Through a series of massive earthquakes, a great rift opened in the continent with deep cracks extending downwards 40 kilometers to the base of the Earth's crust. As these cracks widened, the land between them slumped downwards, leaving a "graben": a valley with sheer escarpments on either side. Views of the northern and southern walls of the graben – the Laurentian Mountains of Quebec and the Opeongo Mountains of Ontario – are a defining feature of Renfrew County.

The newly created Ottawa Valley was transforming into an ocean with Ontario and Quebec on opposite sides - just as a new ocean was appearing between the North American and Eurasian continental plates. But then the rifting stopped and the earthquakes subsided.

Tranquillity followed. North America lay near the equator, drifting slowly northwards. Warm, shallow tropical seas covered the Ottawa Valley. Marine life flourished during the Ordovician Era. Fossils of trilobites, clams and mussels, snails, relatives of squids and octopi, sponges, corals, and sand dollars were deposited in the 450-million-year-old sedimentary limestone that formed over billion-year-old Precambrian rocks. These marine fossils are readily found along the Ottawa and Bonnechere Rivers today.

During a more recent geological era, continental plates again converged to form another great supercontinent, Pangaea. Their collision created another mountain range - the Appalachians – to

the east of the Laurentians. Around 175 million years ago Pangaea split apart and the Atlantic Ocean re-opened, accompanied by more earthquakes and faulting in the Ottawa Valley.

The geological history of the Ottawa Valley was not well understood until the 1960s. Scientists such as the Canadian John Tuzo Wilson agreed that evidence was overwhelming for seafloor spreading and collisions of continental plates. Wilson's scientific contributions were so critical that the cycle of formation and disappearance of oceans is known as the "Wilson Cycle".

The final events in the Valley's geological history took place during a 3-million-year ice age. For 2 million years glacial and inter-glacial periods alternated quickly, lasting about 40 thousand years each. But during the past million years the cycles lengthened to 100 thousand years. Intense cold periods created continental-scale ice sheets.

The last of these, the Laurentide Ice Sheet, flowed southwest from the region of Hudson Bay. It reached the Ottawa Valley around 60,000 years ago, covering the Valley with ice to a maximum thickness of two to three kilometers. When the ice began its retreat around 20,000 years ago, its weight had greatly depressed the land surface, and it held so much water that global sea level had fallen by 70 meters. As it melted the Atlantic Ocean flooded into the lower portions of the Ottawa Valley and formed the Champlain Sea, with its rich diversity of marine life. In 1977, a quarry operation in eastern Renfrew County near White Lake uncovered the skeleton of a bowhead whale.

During their advance and retreat, glaciers scraped over the Ottawa Valley and the Algonquin highlands, exposing bedrock in some places, and dumping materials ("glacial till") elsewhere. For thousands of years the upper Great Lakes and much of Canada west to the Rockies drained through the Ottawa Valley. At maximum flow the Ottawa River rivalled the Amazon in size. Water from the melting ice transported boulders, gravel, sand, and clays, carving deep channels such as the Barron River Canyon. The finest clay-sized particles were carried furthest downriver and deposited in the Champlain Sea, creating some of Renfrew County's best farmland.

Renfrew County residents live in an ancient and special place. Mountain-building forces of continental collisions, combined with the erosive and depositional power of water (both ice and liquid), sculpted the present-day landscapes of the Ottawa Valley - its hills, plains, escarpments, canyons, rivers, lakes and wetlands. Knowledge of this geologic history informs decisions to conserve our precious soils, waters, and biological resources.

*Ole Hendrickson is a forest ecologist and current president of the Ottawa River Institute ([www.ottawariverinstitute.ca](http://www.ottawariverinstitute.ca)), a non-profit organization based in the Ottawa Valley.*