I.S.RIVERS LYON 2018

Geomorphological adjustments of the middle Garonne River downstream of Toulouse (South-West, France) since the 1950s under the effect of in-stream gravel mining

Ajustements géomorphologiques de la moyenne Garonne en aval de Toulouse (sud-ouest, France) depuis les années 1950 sous l'effet des extractions de granulats

Background

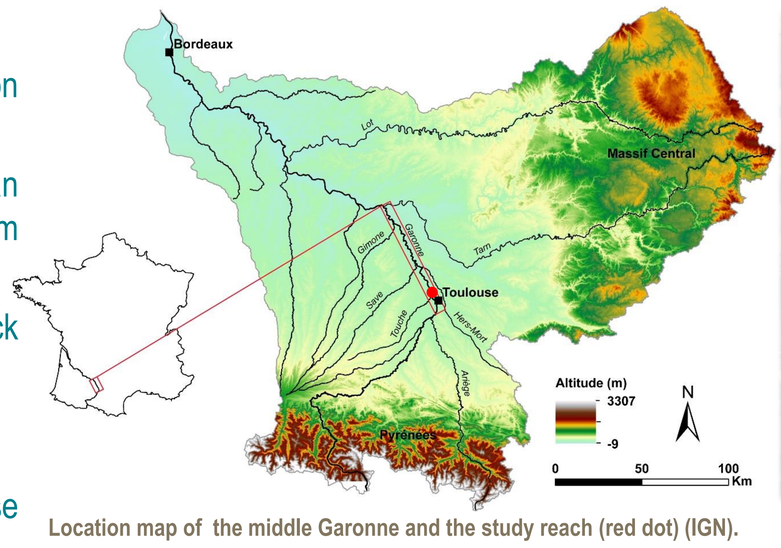
- During the 20th century, significant geomorphological adjustments are observed on the Garonne river leading to channel narrowing (-60 m) and incision (-1,7 m).
- It occurred especially from the 1950s as a consequence of intensive human interventions, such as dam construction, channel works and mainly by in-stream gravel mining with 20 $M.m^{-3}$ extracted in 20 years.
- Nowadays the river presents a significant sediment deficit resulting in bedrock outcrops over 51% of the total channel surface.

Study site

- The study reach is located on the Garonne River, 10 km downstream of Toulouse at the town of Beauzelle.
- Width: 130 m ; slope: 20% ; stream power: 400 $W.m^{-2}$.

Objectives

- Identify the geomorphological changes occurring in the study reach under the effect of in-stream gravel mining during the 2nd half of the 20th century.
- Quantify the riverbed degradation.
- Highlight the transition processes between alluvial channel and bedrock channel.



Location map of the middle Garonne and the study reach (red dot) (IGN).

Aerial image of the study reach, Beauzelle (Haute-Garonne) (IGN).

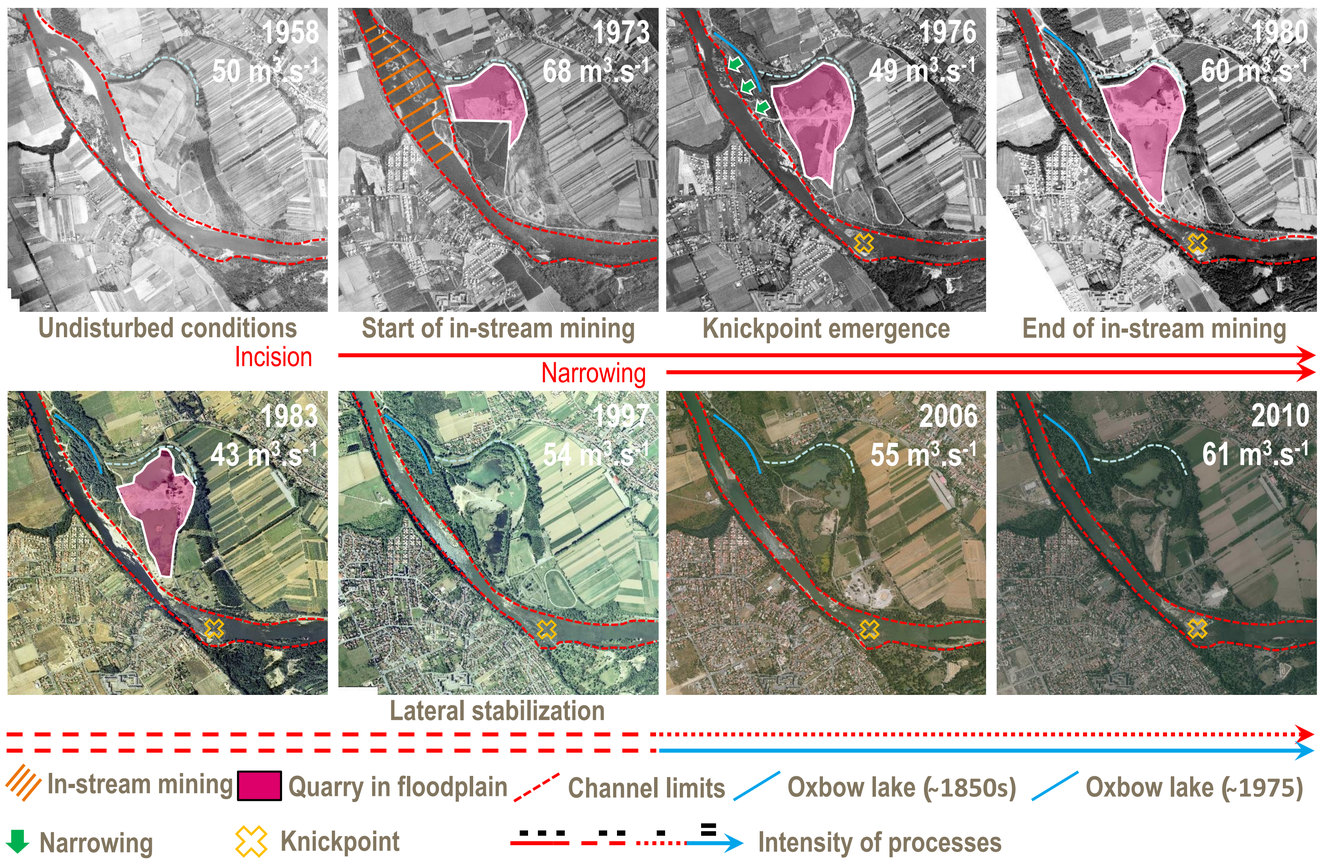
Methods

- Spatial analysis from aerial images:

Aerial images → Georeferencing (1st order polynomial) → Mapping riverbed units → Analyzing geometry (surface area)

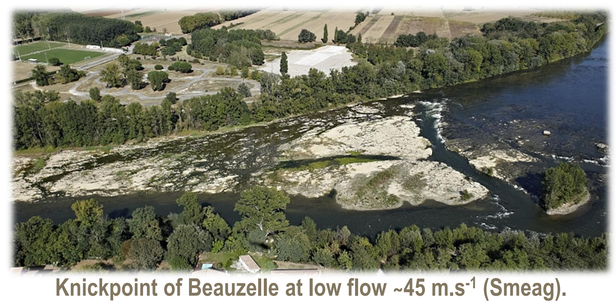
- Topographic data analysis from cross profiles.
- Hydrological data analysis based on flood records.

Changes in channel morphology



Process of incision

- In-stream gravel mining with **389 000 m^3 extracted over the 1970s** according to archive sources.
- In response, the channel experiments:
  - **1)** bed channel load removal,
  - **2)** erosional regression estimated at ~27 $m.an^{-1}$ leading to a gas line rupture (1982) 300 m upstream of the extraction site.



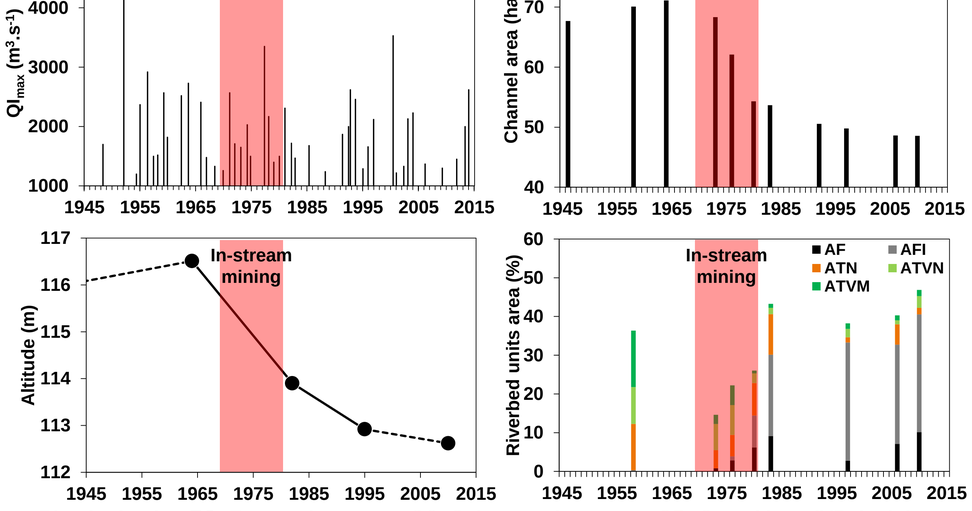
Knickpoint of Beauzelle at low flow ~45 $m.s^{-1}$ (Smeag).

Channel degradation and simplification

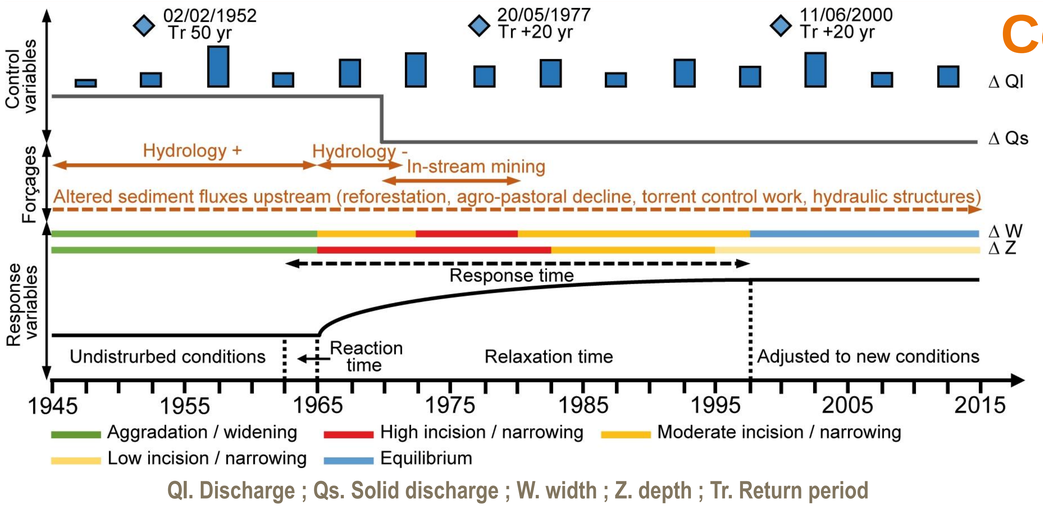
- **Significant narrowing and incision** is recorded between 1960s and 1990s with a **maximum intensity over 1970s** corresponding to the period of in-stream mining:

	1960s-1990s	1970s
Narrowing :	**-61 m / -1,3 m.an^{-1}**	**-38 m / -4,7 m.an^{-1}**
Incision :	**-3,6 m / -11 cm.an^{-1}**	**-2,7 m / -14 cm.an^{-1}**

- Between 1958-2010 **channel morphology experiments drastic changes** with 41% increase in outcrops and 10%-15% decrease in gravel and vegetated bars.



Riverbed units: **EO**. Emerged outcrop ; **SO**. Submerged outcrop ; **GB**. Gravel bar ; **IVB**. Incipient vegetated bar ; **MVB**. Mature vegetated bar.



Ql. Discharge ; Qs. Solid discharge ; W. width ; Z. depth ; Tr. Return period

Conclusion

- This study highlights the role of in-stream mining as the dominant factor in channel degradation at the local scale.
- In-stream mining and lack of sediment connectivity resulted in an incision greater than 4 m and a high sediment deficit.
- Change of incision process from evacuation of alluvial cover by regressive erosion and gradual outcropping of the bedrock to erosion of this latter.
- Appearance of a knickpoint of more than 3 ha with 3 m difference in height.

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