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# Mitigation strategies for radiation damage in the analysis of ancient materials

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## HIGHLIGHTS

- Intense radiation sources are critical to the study of cultural heritage materials
- Radiation side effects may lead to visual alteration or biased analytical results.
- We present and discuss the impacts of irradiation on heritage materials
- We focus on improvements in analytical strategies to mitigate and to monitor damage
- We make suggestions for further research to limit damage to ancient artifacts

## ABSTRACT

The study of materials in cultural heritage artifacts and micro-samples benefits from diagnostic techniques based on intense radiation sources, such as synchrotrons, ion-beam accelerators and laser facilities. While most of the corresponding techniques are classified as non-destructive, investigation with photons or charged particles may fundamental processes that induce changes. These changes depend on irradiation parameters, properties of materials and environmental factors. In some cases, radiation-induced damage may be detected by visual inspection. When it is not, irradiation may still lead to atomic and molecular changes resulting in immediate or delayed alteration and bias of future analyses. We review the effects of radiation reported on a variety of cultural heritage materials and describe the usual practice for assessing short-term and long-term effects. This review aims to raise awareness and encourage subsequent research activities to limit radiation side effects.

### Keywords:

Analytical strategy  
Ancient material  
Artifact  
Cultural heritage  
Ion-beam analysis  
Laser  
Mitigation  
Radiation damage  
Radiation side effect  
Synchrotron radiation

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