



Construction and demolition waste in Macedonia, a study financed by the know-how exchange program SAMCODE promoted by the Central European Initiative

Gianluca Bianchini¹, Ristovski Igor², Milcov Igor², Zupanc Alojz², Natali Claudio³, Salani Gian Marco¹,
Marchina Chiara¹, and Valentina Brombin¹

¹ Department of Physics and Earth Sciences, University of Ferrara, Ferrara, Italy

² GAYA NGO, Skopje, Macedonia

³ Department of Earth Sciences, University of Firenze, Firenze, Italy



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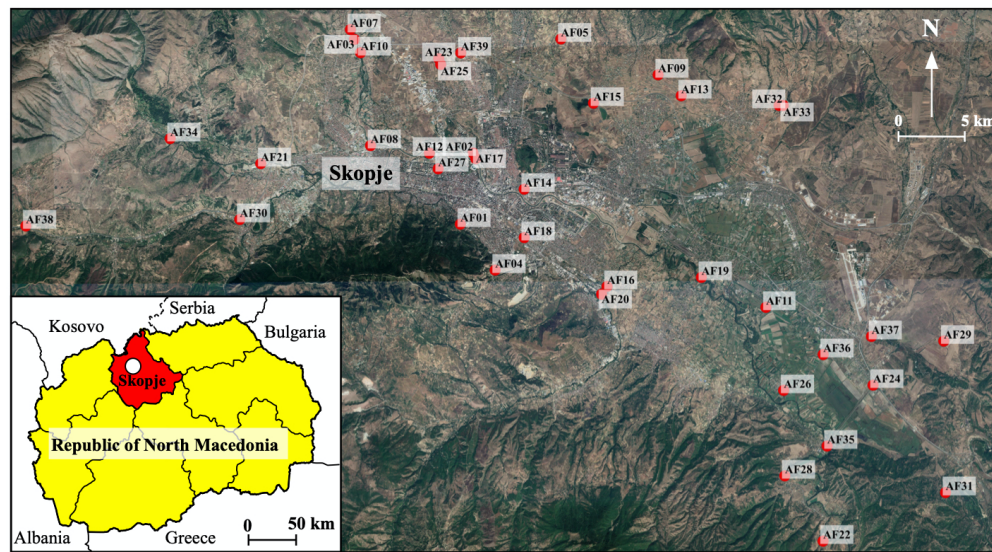
In Republic of Macedonia, **Construction and Demolition (C&D) waste** is often dumped illegally in the environment underestimating its potential recycling and re-use as raw materials in civil engineering works and/or in cement/ceramic industries.

SAMCODE (Sustainable Approach to Managing CONstruction and DEMolition waste) is a know-how exchange programme of the Central European Initiative, the aim of which is a chemical characterisation of C&D waste samples for:

- defining the potential release of hazardous heavy metals in the environment
- evaluating the possible recycling.

**Aim of the
project**

Field survey



From: Bianchini *et al.*, (2020)- Sustainability

Thirty-nine C&D waste samples were collected by NGO GAYA-CER operators (Republic of Macedonia) from different dump sites spread in Skopje city and its surroundings.



The following analyses were performed at the Department of Physics and Earth Sciences (University of Ferrara, Italy).



For C&D waste samples:

- C and N analyses with a Elementar Soli TOC cube following the protocol of Natali *et al.* (2020);
- major and trace element analyses with a X-Ray Fluorescence (XRF) spectrometer.

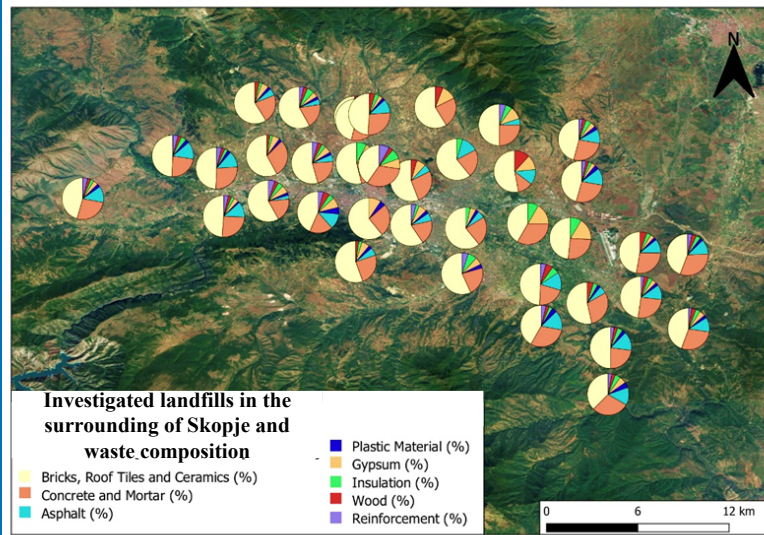
For C&D waste leachates following the UNI EN 12457- Part 2 (2004) methodology:

- trace element analyses with a Inductively Plasma Mass Spectrometer (ICP-MS).

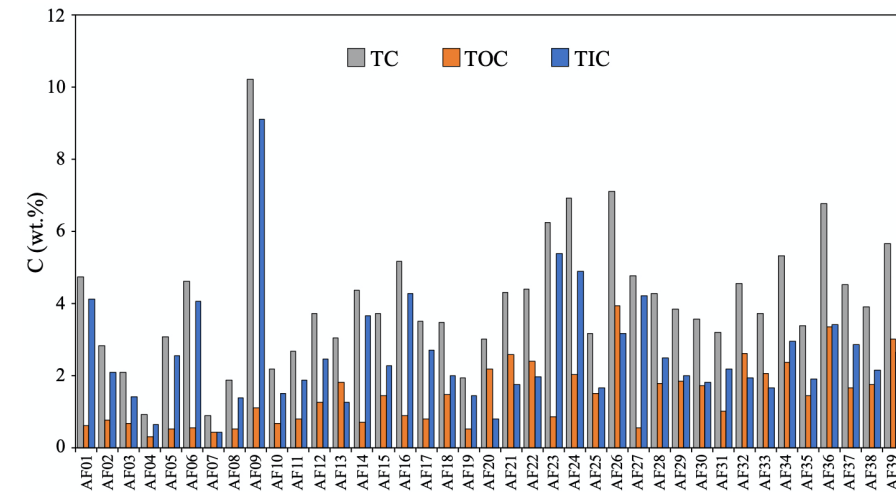


Analytical methods

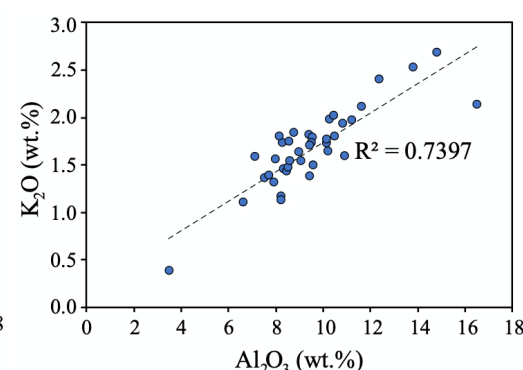
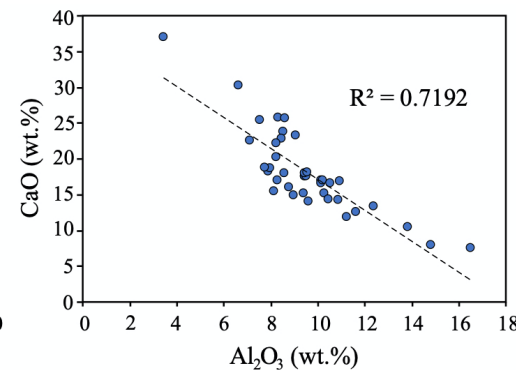
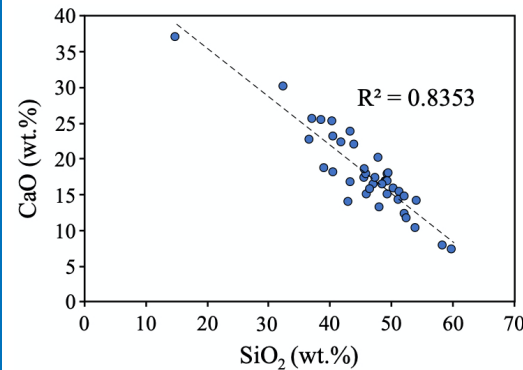
Materials of C&D waste



C&D waste samples are a **heterogenous mixture of materials** (bricks, tiles, ceramics, glass, concrete, and rock blocks), including high amount of inorganic matter (*i.e.*, enriched in inorganic carbon) and low organic matter (*i.e.*, depleted in organic carbon)



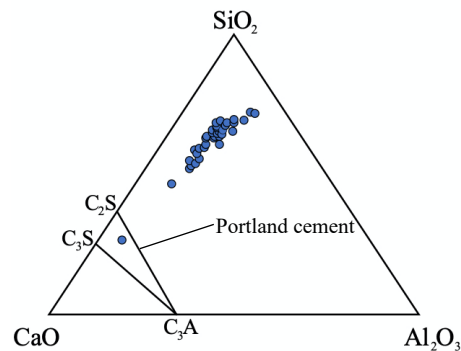
Major elements



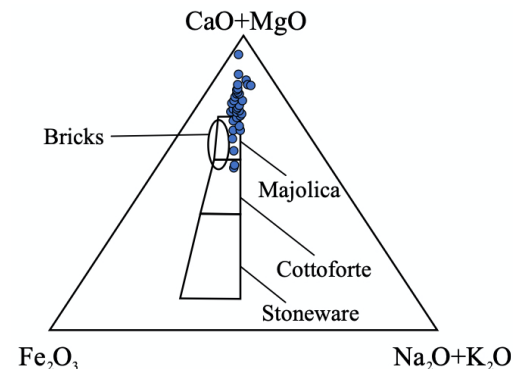
According to the element correlations, the dominant mineral phases are:

- quartz;
- carbonates;
- aluminiferous silicatic minerals.

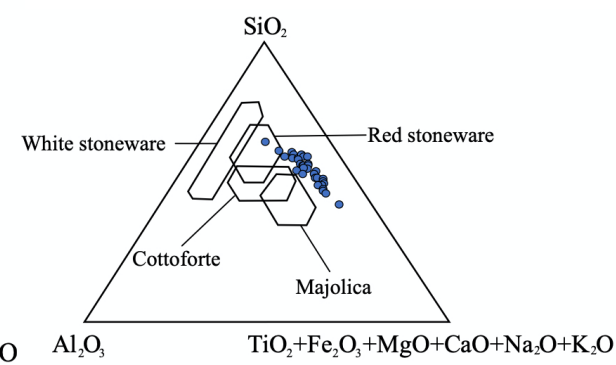
Possible re-use of C&D waste



From: Manning (1995)-
Introduction to industrial Minerals



From: Bianchini *et al.*, (2002)- Periodico di Mineralogia



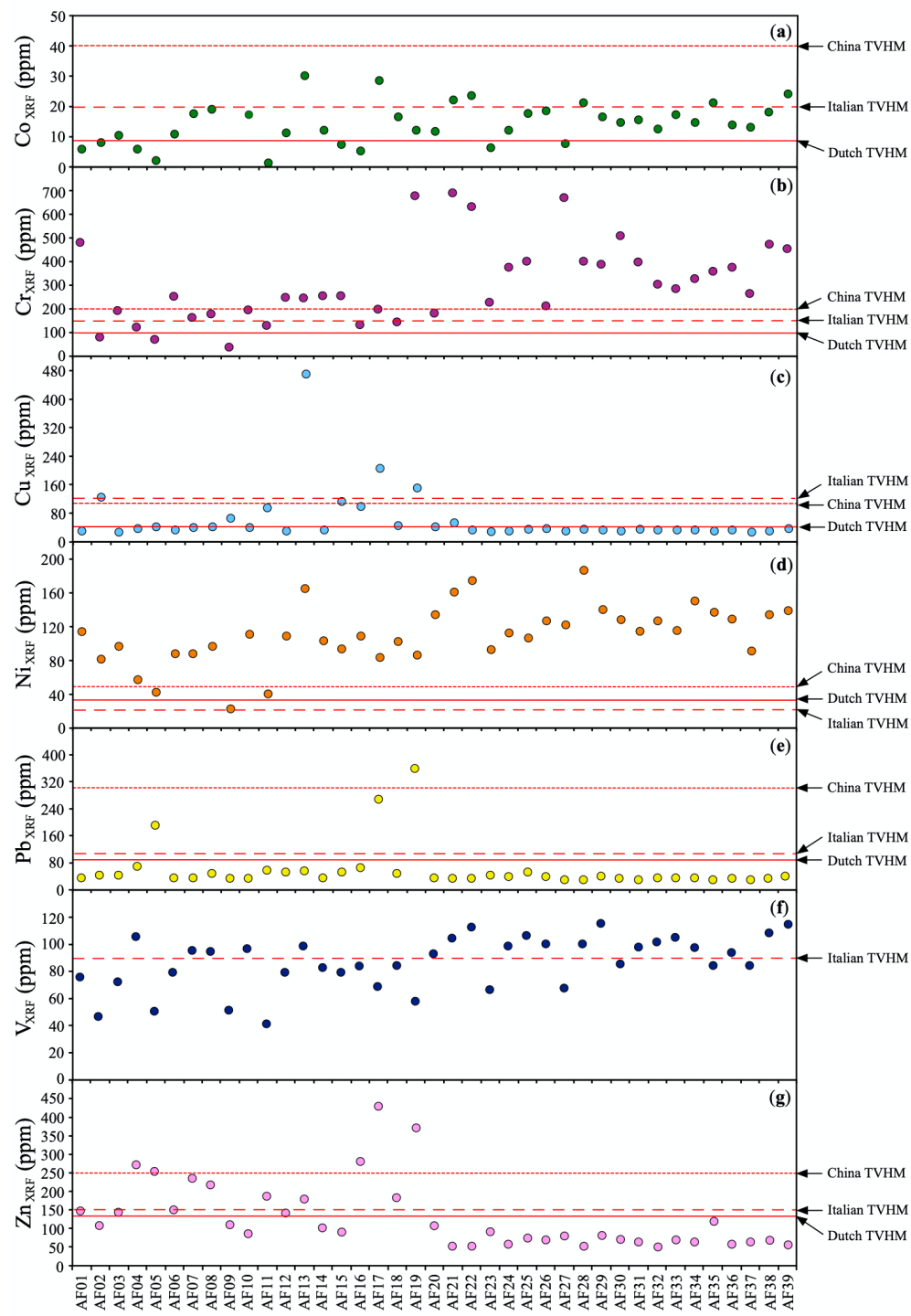
From: Fiori *et al.*, (1989)- Applied Clay Science

The possible recycling of C&D wastes in the cement industrial processes and in ceramic production is hampered by the **lack of homogeneous nature of the materials.**

From: Bianchini *et al.*, (2020)- Sustainability



Potential release of hazardous heavy metals



C&D waste contain concentrations of **Cr and Ni** (and Zn) higher than threshold values of heavy metals (TVHM) usually tolerated for environmental matrices.



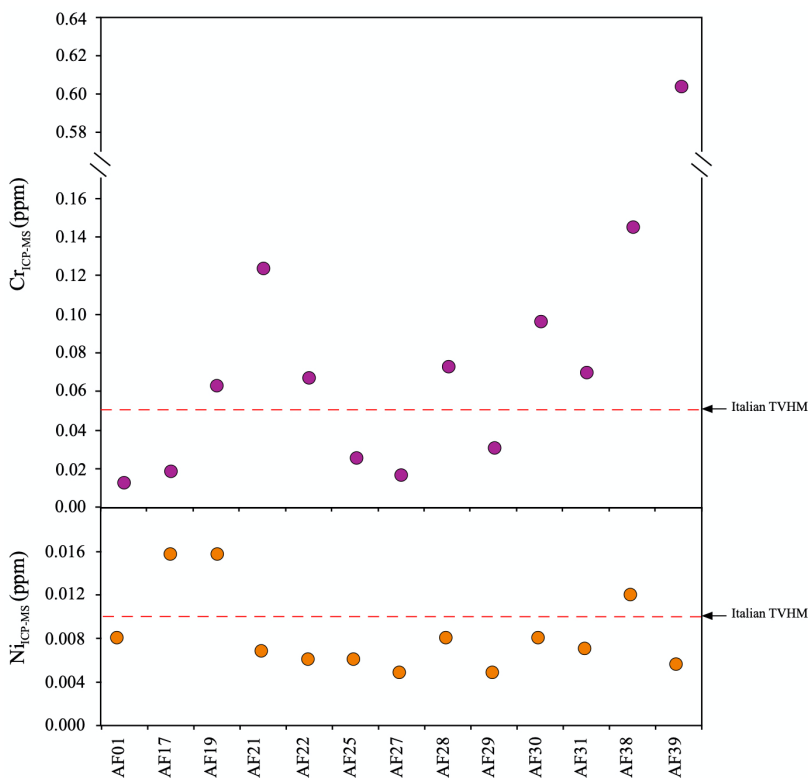
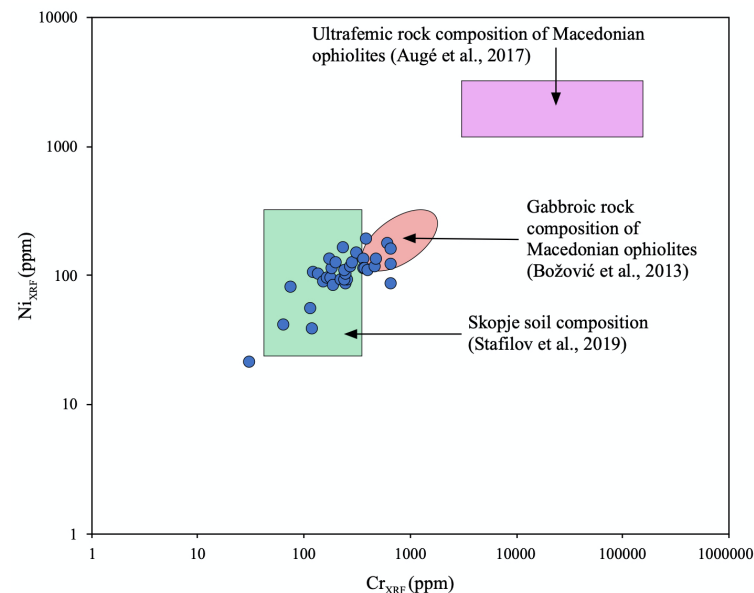
There is a **potential hazard of contamination** of Cr and Ni (and Zn)

In figure:

- Italian TVHM: from soils of green areas used for public/private residential purpose (Italian Legislative Decree 152, 03/04/2006);
- Chinese TVHM: from environmental quality standard soils “Level-II”, to guarantee agriculture and human health (CEPA-Chinese Environmental Protection Administration, GB 15618-1995);
- Dutch TVHM: from environmental quality Dutch standards, beyond which soils are considered contaminated (Dutch Soil Remediation Circular 2009, ESdat).

Geogenic nature of heavy metals

Assessing the real health risk



Cr and Ni are abundant in ophiolitic rocks.
Zn is present in sulphide-bearing deposits.

These matrices are used as raw material in the Macedonian building activity, and therefore remain in the C&D waste.

Cr, Ni, and Zn enrichments are plausibly geogenic

Leaching tests were carried out to evaluate the **mobility of Cr and Ni**.

Leachates have compositions of Cr (and subordinately of Ni) exceeding legislative thresholds concerning reuse of waste materials

The Macedonian C&D waste recycling must be considered carefully due to the **Cr (and Ni) risk contamination**.

In figure:

Italian TVHM: from Italian Law D.M. 5/2/98 and D.M. 186/2006 concerning the reuse of not dangerous wastes as inert material.

From: Bianchini *et al.*, (2020)- Sustainability

Take home message

C&D waste recycling is important and feasible, but needs to be carried out in a suitable framework.

Few collecting centres have to be planned and defined to transfer and stock the C&D waste material.

In such collecting centres a strict **protocol** should be followed:

- registration of the provenance of incoming material;
- elimination of hazardous components for human health (*i.e.*, asbestos, sulphides) before the C&D processing;
- homogenization of C&D waste via sorting, crushing, and grain size selection;
- periodical chemical analyses to prevent heavy metals contamination.

Nowadays, this approach is not followed in Republic of Macedonia, therefore it is important to **sensitise** the operators of building activities as well as local politicians on the correct solid waste management and the importance of C&D waste recycling.

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