

**CETRAHE** – <http://www.univ-orleans.fr/cetrahe>  
**R&D Expertise and Transfer Unit in Tracing Techniques  
 Applied to Hydrogeology and the Environment**  
**Université d'Orléans – Polytech**  
**8 rue Léonard de Vinci, 45072 Orléans cedex 2 – France**



**CETRAHE** is an R & D unit of the University of Orléans, which was created in 2009 with grants from the French State and the Région Centre, as Technology Transfer and Development Project of the State-Region Planning Contract. This project was set up in the cluster Durabilité de la Ressource en Eau Associée aux Milieux, now labeled Pôle de compétitivité écotecnologies DREAM Eau & Milieux. The unit is located in the Polytech'Orléans engineering faculty, with the Institute of Earth Sciences of Orléans (ISTO) as support laboratory. Its continuing education activity is conducted with the Department for Continuing Education and Learning of the University (SEFCO). It is financially managed by the Direction Recherche et Partenariats of the University.

**CETRAHE** aims to continue, deepen and broaden the research, dissemination of knowledge and expertise activities conducted at the University of Orléans by Michel Lepiller until his death in 2006, in the field of artificial dye-tracing applied to hydrogeology and the environment, in order to support consulting and engineering offices, water plants and other industries, water boards, municipal technical services, research and control laboratories, etc. CETRAHE contributes to the activities of the Pôle de compétitivité DREAM Eau & Milieux, mainly as a technology and R&D platform.

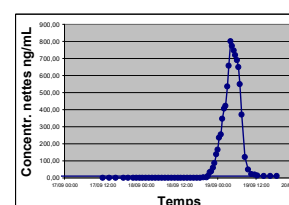
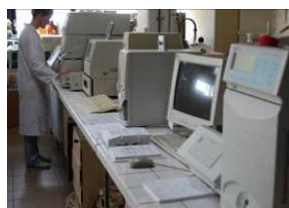
**Artificial tracing** is based on the injection into the water environment of products with specific marker properties (fluorescence, salinity, etc.) to track the pathways of the water, calculate its velocity and residence time in the groundwater systems, etc. This method has many applications in the management of water resources and the environment:

- Delimitation of hydrogeological systems, estimation of their water resources;
- Delimitation of the protection perimeters of catchment works for drinking water supply;
- Studies of the infiltration impact of discharges from wastewater treatment plants in the soil;
- Propagation studies of pollution in natural and industrial environments;
- Impact studies in land management, geotechnical investigations (seepage, leaks ...), etc.

The **main areas of work of CETRAHE** are:

- R&D applied to the improvement, facilitation and expansion of practices and interpretations of tracing techniques (better understanding of the behavior of tracers in the natural environment, finer discrimination between tracers and natural background and particulate matters in waters, development of IT tools to support the interpretation of tests, etc.);
- Consulting and analytical expertise, assistance in the implementation and interpretation of the tracing tests (*see overleaf the rates of the services proposed*);
- Assistance with initial training, especially of students in geo-environment engineering, continuing training, dissemination of knowledge and information on tracing techniques and their applications to the sustainable management of water resources and the natural environment.

**Team, Collaborations, Equipment:** Led by a senior lecturer at Polytech'Orléans and researcher at ISTO, CETRAHE is composed of a research engineer as deputy director, a studies engineer, and is assisted by Polytech'Orléans technicians for training activities. In addition to ISTO and Polytech, CETRAHE collaborates with other research laboratories, public organizations such as BRGM (French Geological Survey; see TRAC software <http://trac.brgm.fr/>), certified hydrogeologists, companies, municipalities and associations such as Spéléologie Subaquatique Loiret (underwater speleologists) or Les Amis des Sources. CETRAHE is equipped with laboratory spectrofluorometers, field fluorometers, spectrophotometers, ion chromatography systems, portable samplers, etc.



### Contacts

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**RATES for consulting and analytical expertise,  
supply of scientific equipment and continuing training  
YEAR 2023 (valid until December 12, 2023)**

**Expertise – Consulting**

- Consulting, field work, data treatment, interpretation of results, writing of conclusions and reports: 790 € HT per day
- Travel: Charged at the standard University rate

**Analytical expertise**

**- Detection and quantification of dye-tracers by spectrofluorimetry**

Hitachi F-7000 Spectrofluorometer (double synchronous scan technique) with AS-3000 autosampler

**Concentration measurements:** 6.00 € HT per tracer and per sample (rate valid for all fluorescent tracers)

Detection limits (*measured on unfiltered samples for commercially available tracers*):

	<u>Optically clean natural waters</u>	<u>Waters with a high background</u>
Uranine	0.001 µg/L	0.01 µg/L
Eosine	0.050 µg/L	0.10 µg/L
Sulforhodamine B	0.050 µg/L	0.10 µg/L
Sulforhodamine G	0.050 µg/L	0.10 µg/L
Naphthionate	0.025 µg/L	between 0.2 and 0.6 µg/L
Tinopal	0.050 µg/L	between 0.2 and 0.6 µg/L
Amino G. Acid	0.100 µg/L	between 0.2 and 0.6 µg/L

**Realization of the calibration line with the tracing product used:** 43.00 € HT per tracer

**Realization of excitation and emission spectra:** 2.00 € HT per spectrum

**- Analysis of dye-tracers in activated carbon detectors ("fluorosensors")**

Extraction + spectrofluorimetric analysis: 17.25 € HT per fluorosensor for one tracer (4 € per additional tracer)

**Supply of ready-to-use fluorosensors:** 6.00 € HT per fluorosensor

**- Realization of "3D" (double scan) excitation-emission fluorescence spectra** (presence of tracers or other fluorescent compounds, characterization of dissolved organic matter ...): 11.75 € HT per spectrum

**- Detection and quantification of ionic tracers by ion chromatography**

Dionex ICS900 ion chromatography system, with RFC30 automatic eluent generator and AS-DV autosampler (anions)

Dionex ICS1100 ion chromatography system, AS-DV autosampler (cations)

**Detection and quantification of ions:** 6.50 € HT per ionic tracer and per sample; 13.00 € HT per ionic series (anions or cations) and per sample

Detection limits of the ion chromatography systems: Br<sup>-</sup>, Cl<sup>-</sup>: 1 µg/L; I<sup>-</sup>: 50 µg/L (5 µg/L by spectrophotometry\*);

Li<sup>+</sup>: 20 µg/L. Actual detection limits depending on natural concentrations in samples: **Contact us for more information**

**Realization of the calibration line with the tracing product used:** 43.00 € HT per tracer

**Determination of total dissolved P:** 20.00 € HT per sample

*Analysis of other anions or cations on request*

**- Realization of spectra by molecular absorption spectrophotometry** (natural color of water, presence of dyes ...)

Hitachi U1900 ratio beam spectrophotometer; wavelength range: 190 to 1,100 nm; 4 nm spectral bandpass: 10.00 € HT per spectrum

*Analysis of ions in waters and solutions on request. (\* Detection limit for I<sup>-</sup>: 5 µg/L.)*

**- Pretreatment of samples** (filtration, dilution ...): 4.25 € HT per sample (2 € per additional pretreatment)

**Supply of scientific equipment** (*Transport and insurance of the equipment under the responsibility of the borrower.*)

**- GGUN-FL30 flow-through field fluorometers for surface waters** (2 devices, pre-calibrated, batteries supplied, computer not supplied): 220.00 € HT per fluorometer and per week; 550.00 € HT a month

**- ISCO 3700 full-size portable sequential samplers 24 bottles** (10 devices):

90.00 € HT per sampler and per week; 290.00 € HT a month

**- Supply of sampling devices:**

Set of 24 ISCO spare bottles: 90.00 € HT a set; box of 25 clean 30 mL brown glass flacons: 19.00 € HT a box

**- Supply of ready-to-use liquid tracers:** Purchase price + 300.00 € HT per tracer for the preparation

**- Supply of calibration solutions for field fluorometers:** 60.00 € HT per tracer for one calibration set

**Continuing training** (*Detailed dates, objectives, program .... See our website or contact us.*)

**- Initiation au traçage hydrogéologique : principes, applications, méthodes, interprétations** (2 days): 1,150.00 € TTC

**- Spécialisation et perfectionnement dans la pratique du traçage hydrogéologique** (5 days): 2,150.00 € TTC