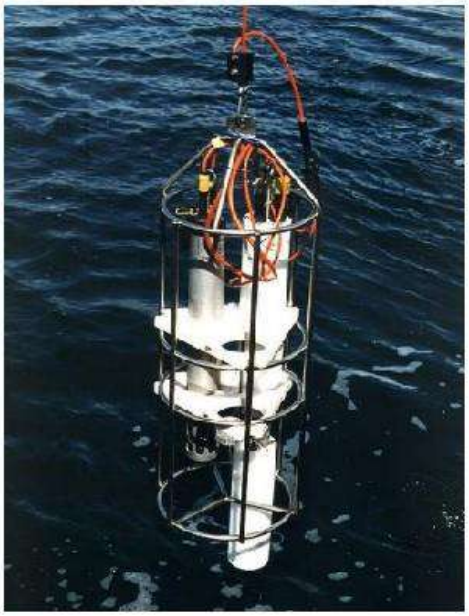
Voltammetric In-situ Profiling system

Introducing the only existing submersible voltammetric probe for in situ trace element monitoring and profile. VIP is a no-compromise, state-of-the-art analytical system to address the requirements of every environmental scientist interested in the monitoring of trace metals in the aquatic ecosystems.

The VIP system consists of these units: the submersible voltammetric probe based on a unique micro-sensor, a submersible pump, an optional Ocean Seven 3xx multi-parameter probe and management software running on any Windows computer. The VIP system allows simultaneous measurements of Cu(II), Pb(II), Cd(II) and Zn(II) with a sensitivity at ng/L level, it can be used both in sea and fresh water. It is controlled either by an operator from the surface, or in autonomous mode, under pre-programmed sequence.

Key features

- **Simultaneous multi-element analysis**
- **Direct detection of the bio-available trace metal fraction**
- **Original, reliable gel protected micro-array sensor**
- **Wide dynamic range (ng/l to mg/l)**
- **Sensor signals independent of the hydrodynamic conditions and pressure in the range 0 to 500 dbar**
- **No interference from inorganic and organic colloids and suspended particles**
- **Easy integration with IDRONAUT multiparameter CTDs**
- **Flexibility of operations: real-time or self-recording**
- **Autonomous data analysis**
- **Windows advanced data analysis and presentation software**



Management software

A user friendly management software allows the user to manage all the functions required by the VIP system for each operating mode. They are: calibration, measurements and profiling, automatic data retrieving, data processing, support of the operator during each phase of the working activities.

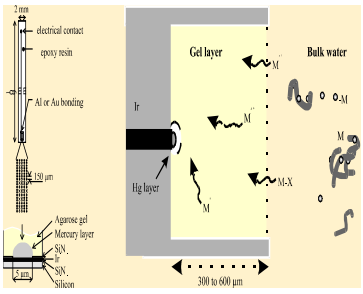
Submersible pump

The submersible peristaltic pump is designed to withstand a depth of 500 meters. The pump housing contains a battery pack which powers the pump and the VIP system.

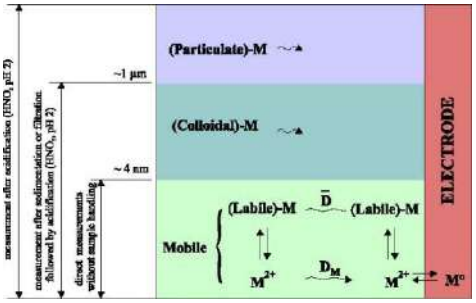
Measurement cell

The measurement cell of the VIP system is specifically designed and It consists of two transparent parts: a flow-through voltammetric cell, and a removal protective housing. The flow-through voltammetric cell is based on a three-electrode system: working, reference and counter electrodes. The three-electrodes are screwed into the flow-through cell; o-ring seals guarantee waterproofness. The protective housing protects the electrode connectors and allows to assemble, via double O-ring seals, the flow-through voltammetric cell at the bottom flange of the VIP system electronic housing.

Flow-through measurement cell



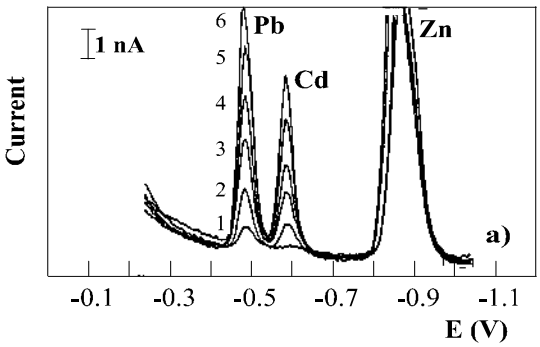
Micro-array sensor

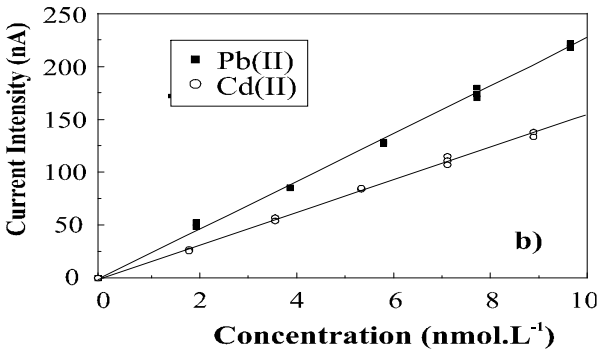


Flow-through measurement cell

Micro-array sensor

The heart of a VIP system is its microsensor. A microsensor (i.e. sensor with a radius ≤ 10 µm) interrogates by anodic stripping voltammetry allows direct measurements of free ions and small labile organic/inorganic complexes representing potentially bioavailable metal forms (often referred to dynamic metal species). Bio-availability of trace metals is of primary concern when considering if trace metals serve as nutrients or as toxicants. Other fractions can be quantified after pretreatment of the samples. However, to perform automatic measurements over extended periods in complex media such as natural waters, most of the currently available sensors are neither reliable nor sensitive enough for monitoring very low concentration of chemical compounds. Moreover, sensor fouling, due to the adsorption of organic and inorganic matters at their surface, is an important limitation of direct voltammetric measurements in complex matrices. The VIP system micro-sensor is an on-chip microelectrode array developed by the Universities of Geneva and Neuchatel (Switzerland) to solve all these problems. It is produced by thin film technology and consists of an array of 5 x 20 interconnected Iridium micro-discs, having a diameter of 5 µm and a center-to-center spacing distance of 150 µm, electrochemically coated by Hg microlayers, and covered by a hydrophilic gel acting as an efficient antifouling protective membrane. Measurements this gel-integrated microelectrode array (GIME) are performed in two successive steps: a) equilibration of the antifouling gel with the sample (typically 5 minutes for a membrane thickness of 300 µm); b) voltammetric analysis inside the gel.





Analytical specification

Measurable compounds and lowest detection limits (15 minutes pre-concentration time)

	Molar Mass (MM)	pM / (nM)	pg/L	ng/L
Cd	112.4	40 / (0.04)	4496	5
Pb	207.2	30 / (0.03)	6216	6
Cu	63.54	250 / (0.25)	15885	15
Zn	65.37	500 / (0.5)	32685	30

Measurement range: 0.2 to 500 nM (5 minutes pre-concentration time)

Measurement techniques

Chronoamperometry: potential range: ± 2000 mV
Cyclic and *Linear Sweep Voltammetry (CSV, LSV)* : potential range: ± 2000 mV, scan rate: 1 mV/s to 1 V/s
Square Wave Voltammetry (SWV, SWASV): potential range: ± 2000 mV, pulse amplitude: 1 to 250 mV
step amplitude: 1 to 250 mV, pulse frequency: 1 to 200 Hz
Hg film deposition: potential range: ± 2000 mV,
Hg film reoxidation: linear potential scan range: ± 2000 mV scan rate: 0.001 to 1 V/s

Technical specification

Power supply: 7 to 30 VDC, 75mA@12VDC
Communications: RS232C up to 115K2 bps, cable length 200m maximum
Potential range: ± 2000 mV, resolution ± 1 mV.
Current measuring ranges: from ± 1 nA to ± 100 µA. Minimum current: 0.1 nA
Data Memory: 4 GigaByte Flash SD-Card (2000 measurements)

Physical characteristics

		VIP System	Pump & Battery
Housing	material	WHITE POM (10 bar)	WHITE POM (10 bar)
Dimensions	housing diameter	100 mm	100 mm
	total length	750 mm	500 mm
Weight	in air about	4.2 Kg	3.6 Kg
	in water about	0.2 Kg	0.8 Kg

IDRONAUT
Via Monte Amiata, 10
20861 – Brugherio (MB) – ITALY
Tel +39 39 879656 Fax +39 39 883382
http: www.idronaut.it
email: idronaut@idronaut.it

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