Revista

# DIVEOPS

2025 - Edition nº 21

## Diving operation

# Bridge Juscelino Kubitschek

REVISTA DIVEOPS

# INDEX

August

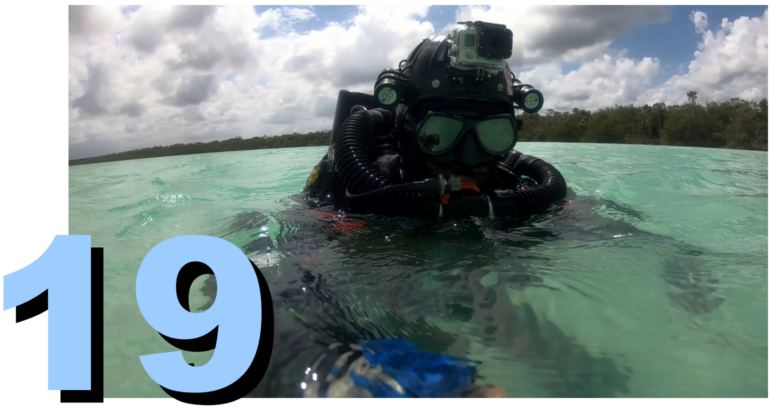

## COVER



## ARTICLES








## EDITORIAL

With each issue, DIVEOPS reinforces its commitment to capturing not only the technique and passion for diving, but also the episodes that mark our collective memory. In this issue, we bring you a special report on the dives performed at the Juscelino Kubitschek Bridge after the tragedy that shook Brazil. More than just technical coverage, it's a deep dive into the combination of courage, solidarity, and professionalism of the divers who worked there. Our goal is to recognize the dedication of these men and women, who transform adversity into a mission, always with the same determination that guides the diving community.



**Contato: revistadiveops@gmail.com**

# CONSELHO CONSULTIVO

LUIZA ALVES
EDITORA-CHEFE

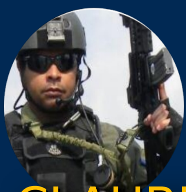
DiveOps magazine was born out of the need for a publication focused on the military, public safety, and commercial diving sectors. For this reason, its editorial line is guided by the consultancy of divers who are references in their respective fields, and together they form our Advisory Board.

Marinha do Brasil
Instrutor de Mergulho

JONE TILLI

Instrutor de mergulho, mergulhador militar e de segurança pública

SANDRO AZEVEDO



Marinha do Brasil
Mergulhador de Combate

CLAUBER MELO

Instrutor TEK, Diretor da Acquanauta e Importador Halcyon

REINALDO ALBERTI

Marinha do Brasil
Mergulhador de Combate

THEO TOSCANO

Marinha do Brasil, Recordista do Guinness e Instrutor de Mergulho

RICARDO BAHIA

Instrutor de Mergulho
Proprietário do Clube do Mergulhador

FLÁVIO JÚLIO

IInstrutor de Mergulho, Instrutor de Caverna e Policial Militar (SP)

RONALDO POSSATO

Marinha do Brasil
Instrutor de Mergulho

ALEX RUBEM

Corpo de Bombeiros (PE)
Instrutor de Mergulho

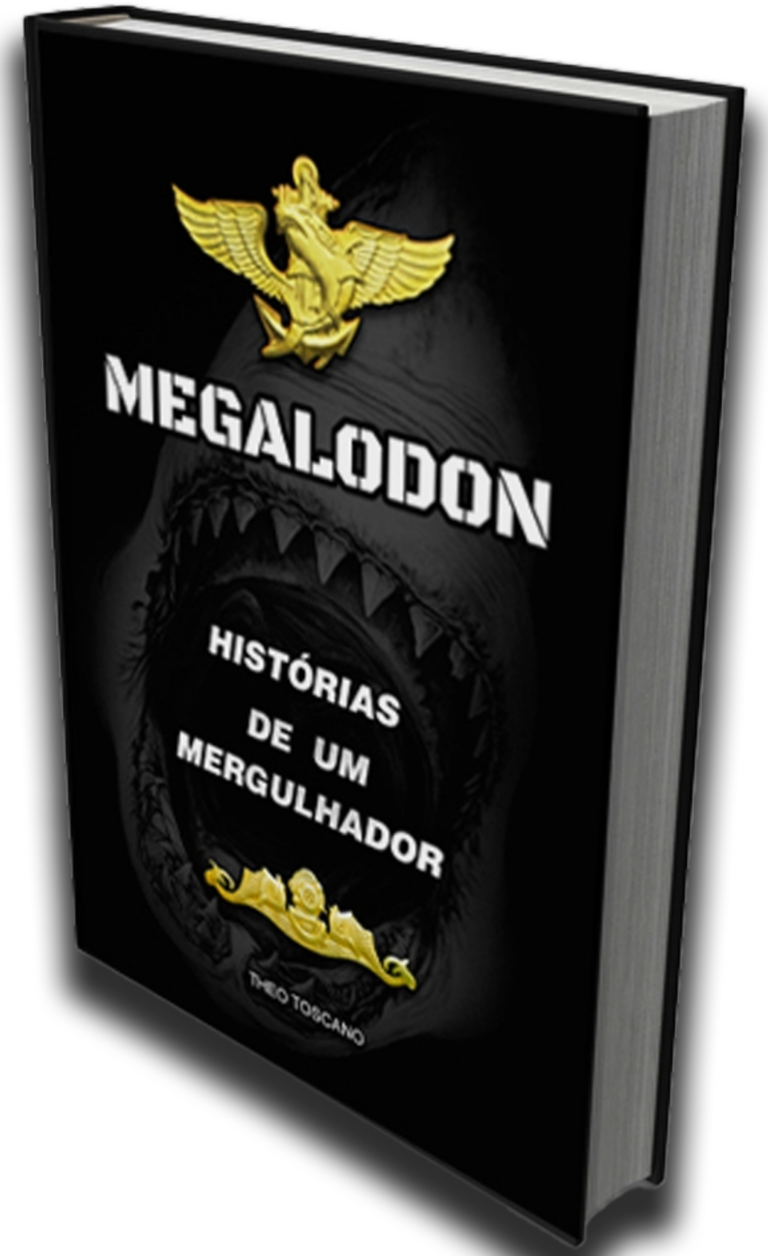
ELTON MOURA

# MEGALDON
## STORIES OF A DIVER

by: Luiza Alves

The The book Megalodon, written by Theo Toscano and co-authored by Alexandre Vasconcelos, marks a new phase in military literature. The work presents a first-person narrative that tells the life story of Commander Toscano, deeply intertwined with the history of diving in Brazil, especially combat diving. Megalodon fills a gap in military literature, being the first book written by a combat diver.

It is a realistic perspective, written by someone who lived the experience, which leads the reader to feel immersed in the world of diving as they read through the pages of this work.




> ***"Unmissable, the first book written by a Combat Diver. The story told by the person who wrote it!"***


# PADI SIDEMOUNT DIVER

STREAMLINED FLEXIBILITY

The Way the World Learns to Dive®

PADI®

# SHEARWATER


The PERDIX 2 is our toughest and most reliable full-size computer yet. The armoured casing with precision titanium surround bezel and dependable titanium piezo touch buttons protect performance-enhanced electronics.

An aluminosilicate glass lens guards a fantastic 2.2” bright screen and offers improved clarity, impact, and damage resistance. A strong vibration customizable alert system draws attention at critical moments of the dive.

Air integration with up to four Shearwater transmitters allows room to grow from a first computer to a powerful, proven advanced technical diving solution. This is delivered using the trusted and easy to find user-changeable single AA battery and familiar ergonomic compact form factor.


# PEDAGOGICAL RUSTICITY

## TECHNICAL STANDARD AND PEDAGOGICAL RUSTICITY

Prof. Dr. Marco Antônio Soares de Souza

Training in scuba diving should not be treated as a mere instructional phase, but as the most decisive moment in qualifying a practitioner for adverse and potentially hostile environments. The underwater environment imposes demands on the human body that are non-negotiable and often unpredictable: currents, equipment failures, sudden temperature changes, pressure perception, low visibility, abrupt sensory limitations, and psychophysiological overload. In this context, initial training requires not only technical mastery but also emotional strengthening structured through simulated, controlled, and pedagogically guided experiences.

Therefore, it can be inferred that training or specialization courses—whether professional or recreational—should adopt as their guiding principles both technical rigor and a form of toughness understood not as a license for arbitrariness or brutality, but as a didactic resource aimed at simulating adversity with a clear and controlled pedagogical purpose. This toughness is manifested through the careful application of exercises under moderate stress, whether through structured instruction or the deliberate use of physical resources that push the student out of their comfort zone and test their self-control, decision-making, and emotional resilience.

The objective is to expose the practitioner, from the earliest stages, to challenges consistent with the demands of the natural environment.

The research conducted by diving instructor Luiz Cláudio da Silva Ferreira, an officer of the Brazilian Army and responsible for aquatic safety during triathlon and open water swimming events at the Rio 2016 Olympic Games, represents one of the most consistent studies on the influence of structural variables in diver training, aiming to justify the use of elements that challenge the student's affective domain. The study focused on students in the introductory course (Open Water), where encountering the unknown is most prominent, and was divided into two phases.

In the first phase, the retrospective performance of students trained at different confined water depths was analyzed, based on 889 technical records. In the second phase, 80 new students were divided into two groups of 40: one trained in a shallow pool (1.5 m) and the other at greater depth (3 to 5 m).

The central variable was technical performance in the exercise of "mask removal, replacement, and clearing" during the first open water training dive.

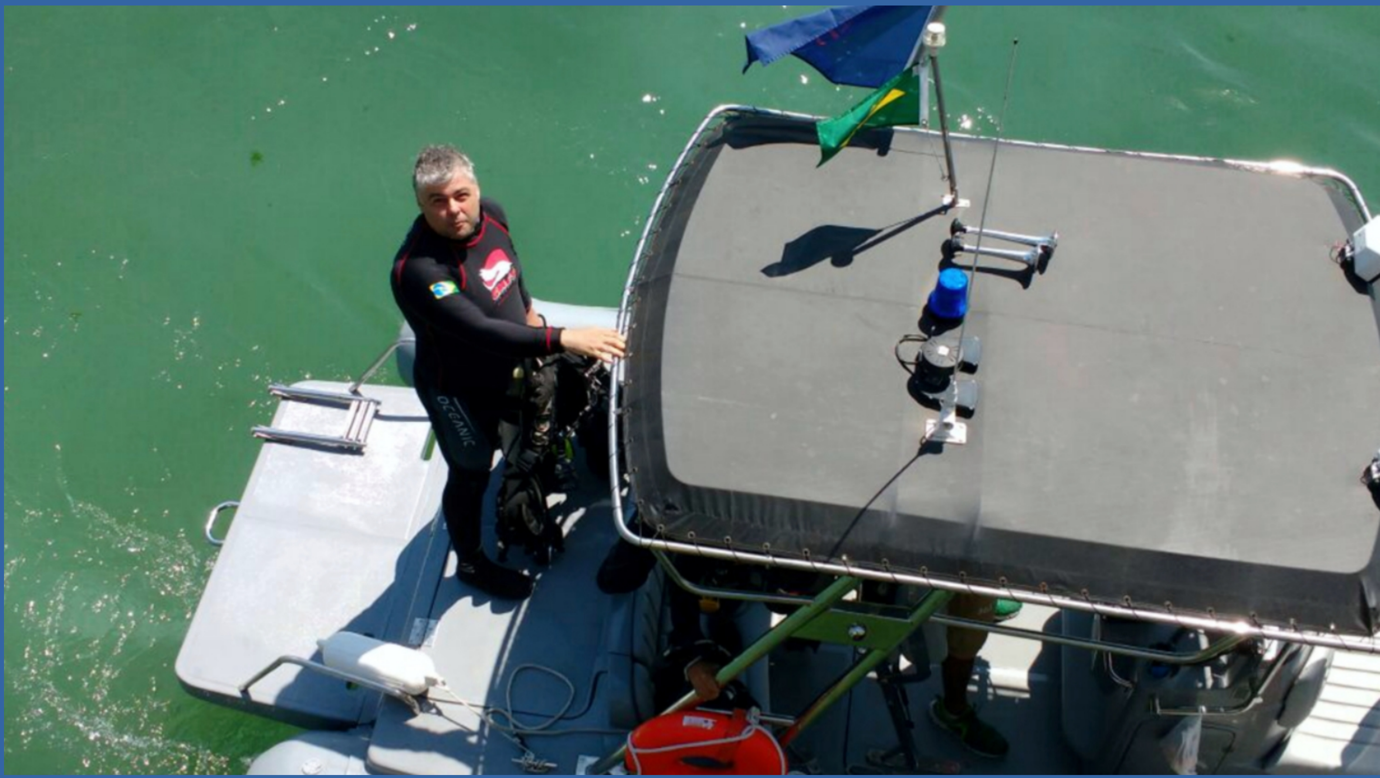
The methodology followed a rigorous standard: both groups attended the same number of classes, taught by equivalent instructors, with a unified pedagogical script, identical equipment, and a common technical protocol. Control variables included water temperature and stress measurement prior to the mask removal exercise in the confined water sessions.

The results were statistically significant: 85% success in the shallow pool group and 96.6% in the deeper group, with no relevant correlation to temperature or prior stress perception. The dataset confirms the hypothesis that greater depth introduces technical toughness useful for training—as a structured pedagogical resource—by more faithfully simulating real conditions: the affective challenge of a larger water column, higher hydrostatic pressure, the need for better respiratory control, and fine buoyancy adjustments.

Other studies support this reasoning. Morgan et al. (2020), in the Journal of Applied Sport Psychology, demonstrated that training incorporating blackout and visual restriction simulations increases resilience and technical efficiency in high-risk sports. Davis & Snyder (2018), analyzing military aquatic training programs, concluded that controlled progression of difficulty—with realistic simulations, unexpected tasks, and orders under pressure—resulted in greater operational safety when applied with supervision and technical rigor.

Removing a mask in a 1.5m pool (source: scientific study by Cel Luiz Cláudio)

Removing a mask in a 5 m pool (source: scientific study by Col. Luiz Cláudio)



These findings indicate that controlled toughness is more than an optional approach: it is a robust pedagogical tool for training divers capable of operating in unpredictable environments. In scuba diving, the goal is not to simulate extreme situations, but to introduce small didactic tensions that compel the student to integrate technical skill and emotional balance.

Neglecting this aspect turns the course into a predominantly comfort-oriented protocol, disconnected from the underwater reality. An instructor who avoids all forms of formative stress prevents the student from developing the ability to respond to the unexpected. Conversely, technical toughness, when legitimized by objective parameters and applied judiciously, fosters a practitioner who is more aware, stable, and confident.

In summary, the educational phase of diving should be conducted with methodological excellence, adherence to international standards, and calibrated pedagogical toughness.

The cited Brazilian study provides a valuable contribution by demonstrating, with method and evidence, that depth in training can be more than a logistical requirement; it can be a critical factor for the student's comprehensive development and for the effective use of resources by the instructor or school. This technical toughness, far from being synonymous with arbitrary harshness, should be understood as an expression of commitment to reality, safety, and the true preparation of the diver.

# *Diving operation*

# Bridge Juscelino Kubitschek

Por: Leone Willians


On December 22, 2024, the Juscelino Kubitschek Bridge, which connected the states of Tocantins and Maranhão over the Tocantins River, collapsed. The fall of the central section of the bridge resulted in the loss of four trucks, two pickups, one car, and three motorcycles, causing 18 casualties: 14 fatalities, 3 missing persons, and 1 survivor.

On the afternoon of December 23, the Head of the Diving Department at the Almirante Castro Silva Base (BACS) notified the military personnel of “Division-K” about their participation in the joint task force (FTG), mobilized and commanded by the Brazilian Navy. On December 24, the officer in charge of diving operations arrived on-site for reconnaissance, preliminary analyses, and the organization of activities in cooperation with the Northern Naval Patrol Group (4DN) and the Fire Departments of Tocantins, Maranhão, and Pará.

On December 25, the BACS team was officially activated, beginning the mobilization and logistical preparation phase. Based on information collected by the teams already on site, it was concluded that dependent diving would be necessary due to the complexity of the tasks, such as victim recovery and refloating submerged vehicles. Factors such as strong currents, obstacles, debris, depths exceeding 35 meters, potential use of special tools, and water contamination, among others, significantly increased the mission’s difficulty and reinforced the need for coordinated interoperability among the different agencies and their divers.

To meet these demands, Division-K selected equipment including special hydraulic tools, a hyperbaric chamber, scaffolding for grade 1 contaminated water diving, a complete Dependent Diving station, technical diving gear, lift bags, refloating pontoons, and remotely operated vehicles (ROVs). The equipment and team were transported aboard two KC-390 aircraft of the Brazilian Air Force.

Upon arriving in Estreito, MA, the logistical challenge of establishing a dependent diving station at strategic points in the accident area became evident. With the support of the City Hall and civil society, two unpowered barges were obtained, which could be adapted to accommodate the diving apparatus and moved with the aid of small boats, with one barge fitted with an outboard motor.

One barge was equipped with the control console (radio, video) and diver equipment, while the other received the main air supply (rack of 12 cylinders of 50 liters), hydraulic tools, compressor, and refloating equipment. Dependent diving operations commenced on December 28.

## Challenges and Complexity

Diving operations in the Tocantins River revealed increasing complexity due to adverse conditions. The riverbed featured a variety of debris, variable depths, loose rebar and cables, increasing the risk of entanglement. Hazardous materials were also present, including pesticide drums from a truck's cargo, as well as wood and metal from submerged vehicles, highlighting the potential risk of water contamination. Should contaminated water diving techniques be required, only a few military personnel possessed the specialized knowledge, underscoring the importance of expanded training in this area. Strong currents and low visibility reinforced the need for meticulous planning and advanced technology.

Throughout the operations, the complexity of the dives proved to be a constant. The riverbed contained diverse debris, variable depths due to the river gradient, loose rebar and cables creating entanglement hazards, pesticide drums, wood from another truck, vehicle metal parts, and strong currents. All of these factors made careful planning imperative for mission success. It is also important to note that victim recovery in such situations is further complicated by the positive buoyancy caused by gases released from decomposing bodies, making handling and maneuvering difficult when obstructed by structures on the riverbed.

To improve the accuracy of planning and execution, teams were divided into technical diving, autonomous diving, dependent diving, and ROV units. As technical divers—primarily from the Tocantins Fire Department, and later from the Navy and the Fire Departments of São Paulo and Brasília—conducted inspection and reconnaissance dives, it became possible to plan operations using the most effective diving technique for each objective. One example of an operation involving interoperability among all teams and diving techniques was the refloating of a VW Voyage, from which the bodies of two victims were recovered. Technical divers inspected the vehicle and confirmed the presence of the victims inside, MARDEP divers installed the refloating device, and autonomous divers executed the refloating from points closest to the surface and inspected the device after installation.

It is worth highlighting that diving is a fundamental operational skill for the Brazilian Navy, playing an essential role in various activities, particularly rescue and salvage. The ability to operate in extreme and otherwise inaccessible environments gives divers a unique strategic importance in operations.

## Results and Lessons Learned

The operation resulted in the rescue of 14 victims, the refloating of two vehicles, and the clearance of a submerged pickup truck. Several lessons and reflections can be drawn, specifically regarding logistical capacity, interoperability, and technical training. These concepts are highly valued in Navy diving and were successfully demonstrated in a crisis scenario. Furthermore, the experience at the border between Maranhão and Tocantins provided a unique opportunity for learning and for advancing the Special Diving Activity in the Brazilian Navy. Three main areas of learning stand out:

1 – Logistical Capacity:

The experience highlighted the need for modular containerization of diving equipment, similar to the model used by the U.S. Navy's MDSU-2. This adaptation would increase flexibility and speed in future mobilizations.

2 – Interoperability and Technical Training:

The synergy among the various teams was fundamental to the mission's success. It is recommended to intensify joint training exercises and exchanges with other national and international institutions, fostering standardization of techniques and protocols.

3 – Operational Adaptation:

The use of dry suits and technical diving, although not routine techniques in the Brazilian Navy, proved highly effective in crisis scenarios. It is essential that these techniques be widely incorporated into diver training.

In addition to developing essential skills, Navy divers often face unique challenges during operations, such as environments with pollutants, debris, and even underwater mines. Exposure to contaminants poses health risks, while submerged obstacles increase physical hazards, requiring advanced skills in equipment handling and problem-solving under adverse conditions. Technological innovations and modern equipment play a crucial role in enhancing operational capabilities, especially in sensitive situations like victim recovery following the collapse of the Juscelino Kubitschek Bridge. Continuous investment in cutting-edge technology and military training is indispensable to ensure operational readiness across a wide range of missions, reinforcing the strategic role of the Navy in maritime defense and security for the Brazilian population.

# Future Vision

Due to the particular nature of the mission, especially regarding its geographical aspects, the logistical challenge of remaining capable of operating across the entire national territory became evident. Although most of the necessary equipment was available for this mission, mobilization, organization, and readiness proved complex given the circumstances. The fact that the equipment is the same as that used at BACS, which benefits from a more developed infrastructure and greater physical space, created a difficult need to adapt the materials to the facilities available in the Maranhão city. Additionally, the weight of the equipment and the boats provided formed a challenging combination, resolved by linking two barges to create the dependent diving station.

In 2022, there was an exchange between BACS divers and the U.S. Navy's MDSU-2 (Mobile Diving and Salvage Unit), during which the great logistical flexibility of the American unit was observed, particularly due to the packing of all the material required for a dependent diving station into just five small 10-foot containers. Considering this adaptation by the counterpart team to their operational needs, a similar strategy could be established as a goal for Division-K.

By maintaining a fixed set of equipment for use at BACS and the Rio area, and fostering a specific kit for operations outside the base, there is the possibility of maintaining full operational diving capacity in multiple locations, addressing both emergency situations and operational needs. This modular equipment approach would facilitate the installation of complete diving stations in hard-to-reach areas, as well as enable training exercises and exchanges outside the Brazilian Navy's scope.

Regarding interoperability and technical training, the preparedness of Division-K divers stands out, as they were able to operate in dives alongside all represented institutions and employ all diving techniques required for the operation (autonomous diving, technical diving, and dependent diving). The skill of the firefighter divers present in the Tocantins River mission certainly encouraged the Division-K team to pursue exchanges and strengthen ties among the different divers.

The unique experiences of the teams were indispensable: one was more accustomed to river diving, another to technical diving, another to diving in contaminated waters using dry suits, and another to dives involving more complex bottom work and refloating operations. The synergy among the diving professionals was therefore the main factor behind operational success at the "tip of the spear."

Moreover, the operation highlighted the importance of maintaining and disseminating training in technical diving and dry suit diving within the Brazilian Navy. Although these techniques are not routinely employed, their effectiveness and safety were fully explored and confirmed during this mission, offering an interesting intersection between the advantages provided by MAUT and MARDEP in specific scenarios. The fact that Division-K and CIAMA already possess the equipment and knowledge for these techniques makes them a subject of interest to be further and more widely explored and disseminated among Navy divers.

Training: Promote widespread training in technical diving, contaminated water diving, dry suit diving, and ROV operations.

Modernized Equipment: Invest in the acquisition of new ROVs, gas analyzers, lift bags, and other specialized equipment.

Standardized Protocols: Develop detailed manuals for complex underwater operations.

Interinstitutional Collaboration: Strengthen ties with Fire Departments, civilian organizations, and international institutions.

This operation reaffirmed to society the high technical, moral, and professional standards of the Brazilian Navy, and particularly of the divers involved in this mission. The dedication and competence of the divers, even under adverse conditions regardless of logistical and operational challenges, absence during a festive period, or distance from their usual workplaces ensured the success of the operation and fulfilled the mission of providing solace to the victims' families through a dignified farewell to their loved ones.

The nobility, complexity, and risk of special military diving go hand in hand, and all divers present in this operation confirmed not only their awareness of this interdependent relationship but also their profound pride in the profession they have embraced and in the significance of their work.

Finally, may this tragic experience further foster growth, improvement, development, and cooperation among divers not only within the Navy but also in other civil and military organizations. There should be no restriction or limitation on the knowledge and enhancement of technical and material capabilities in Special Diving Activities. These elements can and invariably will be decisive differentiators of unparalleled magnitude in a wide range of diving operations, whether routine or in crisis situations ■

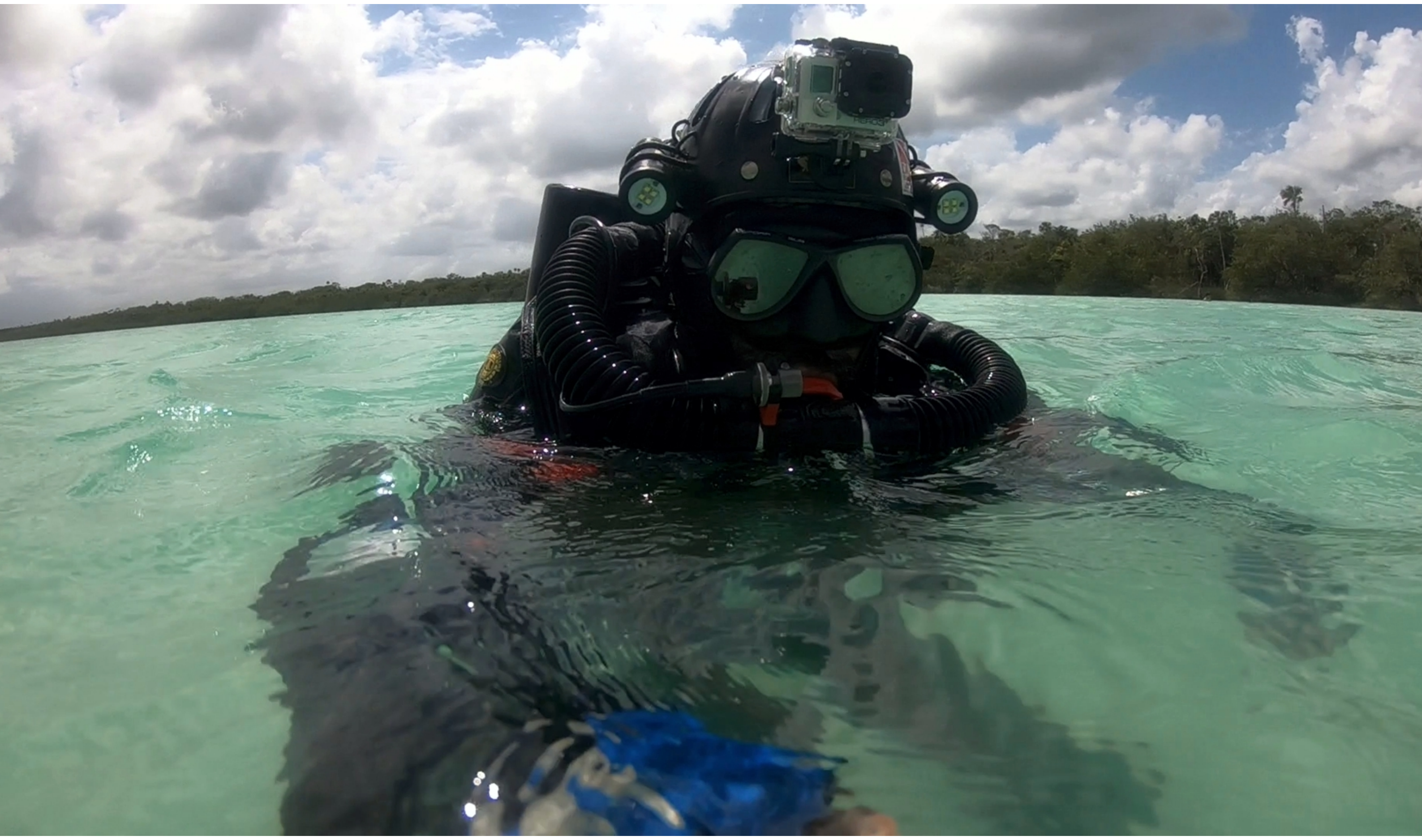
HAQUAZ

ENGENHARIA SUBAQUATICA

# FROM SCUBA TO CLOSED CIRCUIT

## THE PSYCHOPHYSIOLOGICAL TRANSITION FROM SCUBA TO CLOSED CIRCUIT (CCR)

Por: Luiz Cláudio Ferreira



**The** transition from traditional open-circuit SCUBA to a CCR (Closed-Circuit Rebreather) involves not only equipment replacement but a complete overhaul of the diver's situational awareness. In open-circuit diving, the continuous sound of the breathing flow acts as a marker of physiological normality. In a CCR, this sound disappears, requiring the diver to restructure their sensory map, developing greater attention to proprioception and continuous instrument monitoring. The absence of bubbles alters environmental perception and also affects orientation, breathing rhythm, perception of exertion, and the level of sustained cognitive alertness throughout the dive.

Respiratory resistance in a CCR is significantly higher. This resistance is influenced by depth, the density of the gas mixture, and the condition of the scrubber and the loop. Trimix mixtures, with added helium, reduce the ventilatory load but do not eliminate the risks associated with hypercapnia.

The subjective perception of safety is reduced by the absence of auditory cues, forcing the diver to continuously monitor $PPO_2$ fluctuations, sensor performance, and the integrity of the breathing system.

This requires mastery of one's own ventilation under exertion, constant mental discipline, and the ability to recognize subtle signs of respiratory compromise early, before they develop into significant physiological events. The transition causes psychological discomfort even in experienced divers. The absence of familiar SCUBA sensory markers triggers adaptive anxiety, which can escalate into decompensation if not properly managed. Conscious breathing techniques, focused attention, and stress-load simulations help condition the emotional response. Confidence built over years of conventional diving must be replaced by a new self-assurance grounded in technical doctrine, mastery of complex systems, and assimilation of the operational risks inherent to closed-circuit diving.

In a CCR, vigilance must be constant. Scrubber failures, uncalibrated sensors, and $PPO_2$ deviations from setpoints do not produce immediate audible alerts. The diver must anticipate operational deviations through frequent monitoring of critical parameters and perception of subtle respiratory variations. This demands cognitive discipline, operational memorization of contingencies, and assimilation of typical circuit failures. Breathing management becomes deliberate rather than instinctive.

Beyond technical mastery, a CCR diver must integrate advanced cognitive skills, such as prolonged focus, silent-failure management, and decision-making based on dynamic physiological data. Response protocols must be internalized, and the use of mental or physical checklists should be institutionalized in the dive routine.

The most recent didactic approach adopted by schools proposes that CCR fundamentals be trained in modular and isolated stages before full integration of the system at depth. This model reduces initial cognitive overload and allows students to progressively develop a conscious relationship with key circuit elements—such as $PPO_2$ monitoring, valve checks, and interpretation of loop dynamics. Training based on operational micro-competencies builds a solid foundation for critical decision-making, establishing response patterns that can be automated without compromising subjective vigilance.


BARE
HALCYON

Advanced training should include simulated scenarios with $PPO_2$ failures, sudden increases in respiratory gas density, and exercises for early identification of hypercapnia. The ability to maintain psychophysical stability under these conditions defines safety in extreme environments. CCR extends the limits of time and depth but demands constant technical vigilance and a new level of underwater self-management. Every decision must be made based on critical assessment of parameters and continuous ventilatory self-awareness, incorporating mastery of respiratory physiology as an inseparable part of operational conduct.

The transition to CCR represents an operational paradigm shift. While it offers advantages such as greater autonomy, improved hydrodynamics, and precise control of the breathing mixture, it imposes a new psychophysiological and cognitive load on the diver. The success of this transition depends on the integration of technical knowledge, real-load training, emotional mastery, and full respiratory awareness.

CCR training should incorporate realistic simulations, structured doctrine, and progressive adaptation to operational silence, so that the diver learns to perceive risks not through obvious external cues, but through internal reading of their own physiological responses.

Full understanding of this transition involves not only modifying breathing techniques but adopting a new logic of internal command and psychophysiological supervision. It is about operating in an environment where the absence of noise does not signify calm, but a potentially dangerous silence. Safety in CCR does not lie in apparent comfort, but in the mental and operational framework that the diver builds before each dive ■

*The primary mission of the Hall of Honor is to recognize and pay tribute to all men and women who have distinguished themselves in a notable manner, contributing significantly to the advancement and enrichment of diving in Brazil.*

THEOTONIO TOSCANO
LUIS OLIVEIRA
JONE VIEIRA TILLI
KADU PINHEIRO
RONALDO POSSATO
SANDRO AZEVEDO
LASZLO MOCSÁRI

Revista

DIVEOPS

WWW. DIVEOPS.COM.BR - Revistadiveops@gmail.com