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Newsletter

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Institute for National Defense and Security Research

No. 172, Bo'ai Rd.,

Zhongzheng Dist., Taipei City-100057

Taiwan (R.O.C.)

<https://indsr.org.tw/en>

The Development Trend of PLA Submarine Stealth Technology

Tzeng-Yuan Heh
Research Fellow

Division of Cyber Security and Decision-Making Simulation

Topics: Military Technology, Warfare Tactics

1. News Highlights

According to a South China Morning Post report on March 24, researchers from Beijing Institute of Technology have developed a new submarine coating material using rare earth elements. The “active magnetic tiles” that take advantage of the technology, known as “giant magnetostrictive materials,” can generate low-frequency sound waves of 147-decibel that transform passive reflection into active emission. The active magnetic tiles can reflect enemy sonar frequencies and produce low-frequency,

high-decibel echoes, causing enemy sonar operators to mistake the sound for ordinary ocean noise. The report suggests that China’s abundant rare earth resources give it a unique advantage in developing and applying this technology, potentially threatening the US Navy with improved Chinese submarine stealth capabilities.¹ Based on news reports, it appears that China has utilized its ample mineral resources to expand its research and development efforts, resulting in the creation of impressive military technologies.

1. Stephen Chen, “Chinese Scientists Say New Stealth Tech for Submarines Can ‘Cancel Out’ US Navy Sonar,” *South China Morning Post*, March 24, 2023, <https://www.scmp.com/news/china/science/article/3212279/chinese-scientists-say-new-stealth-tech-submarines-can-cancel-out-us-navy-sonar>; Cai Yuting, “Submarine Becomes Water? China Claims Their Stealthy Submarine Coating Can be Disguised as ‘Water’, Making Sonar Echoes Undetectable by the US Navy,” *Newtalk News*, March 28, 2023, <https://newtalk.tw/news/view/2023-03-28/863904>.

2. Security Implications

2-1. Making detection more difficult

To enhance stealth capabilities, submarine development typically focuses on three aspects: 1. propulsion systems, 2. geometric shapes, and 3. surface coating properties. The most advanced submarines today, such as the US Virginia-class and Seawolf-class nuclear-powered attack submarines, produce noise levels only 5 decibels above the average ocean background noise (90db) when submerged.² Conventional diesel-electric submarines, however, produce more noise during operation, as evidenced by the 2003 disaster involving China's Ming-class 361 submarine, which was likely caused by experiments to reduce noise from the conventional propulsion system.³ In addition, submarine propellers are another significant source of noise

during operation.⁴ As for the geometry of submarines, a "teardrop-shaped" hull design is generally adopted to reduce the seawater resistance. Thus, coating properties have become a critical factor in enhancing submarine stealthiness besides propulsion systems. The aforementioned "active magnetic tiles" produce 147-decibel sound waves that fall within the low-frequency range emitted by whales (155 to 188 decibels).⁵ This led to an incident where a PLA Kilo-class submarine was initially mistaken for a whale by the British Queen Elizabeth-class aircraft carrier using sonar detection but was eventually correctly identified through sound reflection spectroscopy.⁶

2-2. Unique characteristics of Rare Earth Elements

Sound travels five times faster in water than in air, making transducers for

2. Wang, Zhipeng, "The Advanced US Submarines are Difficult to Detect, but will 'Quantum Technology' Change the Global Military Balance?" *EToday*, April 11, 2021, <https://forum.ettoday.net/news/1957365>.

3. He, Zeng-yuan, "A Study on the Chinese 361 Submarine Accident," *Naval Academic Monthly*, Vol. 38, No. 6, pp. 77-81, 2004.

4. Lin, Cheng-guei, "Study on the Intelligent Automatic Rudder Control of Submarines Maneuvering Underwater in A Low-noise, Stealthy Manner," *CSBC Quarterly*, Vol. 44, No. 1, pp. 67-86, March 2023.

5. Kieran Mulvaney, "The Loneliest Whale in the World?" *The Washington Post*, January 26, 2017, <https://www.washingtonpost.com/sf/style/2017/01/26/the-loneliest-whale-in-the-world/>.

6. Li, Jingtang, "China Claims to Master New Submarine Technology that Cheats US Navy Sonar without being Detected," *TVBS News*, March 28, 2023, <https://news.tvbs.com.tw/world/2081178>.

emitting sound signals and hydrophones for receiving widely used in anti-submarine detection.⁷ As the speed of sound propagation depends on the medium,⁸ the use of rare earth element coatings that generate low-frequency, high-decibel echoes that may lead to misjudgment becomes a new trend in stealth research.

Rare Earth Elements (REEs), or rare earth metals, are seventeen metal elements and belonging to Group 3 elements on the periodic table, including lanthanum, terbium, and dysprosium, among others. A common analogy is that if oil is “the blood of industry,” then rare earths are the “vitamins of industry.” China boasts abundant rare earth reserves, ranking first

globally in terms of reserves, production, and exports. Lanthanum (La), derived from the Greek word “lanthanon” meaning “hidden,” has high refractive properties and can be applied in various areas, such as piezoelectric, thermoelectric, and magnetoresistive materials. Terbium (Tb), mostly used in high-tech fields, contributes to the magnetostrictive effect, causing changes in the shape and size of soft magnetic materials upon magnetization, thereby altering sound wave reflections. Dysprosium (Dy) also exhibits the magnetostrictive effect.⁹ Since these REEs are produced in China, they allow Chinese research teams to enjoy a competitive advantage.

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7. “NCSIST Introduces New Product: Transducer,” *NCSIST*, https://www.ncsist.org.tw/csistdup/products/product.aspx?product_Id=595&catalog=38.
 8. Lee, Chung-Yi and Tsai, Chi-Shen, “The Propagation of Sound,” *Science Online*, January 6, 2011, <https://highscope.ch.ntu.edu.tw/wordpress/?p=19289>.
 9. “Popular Rare Earth Knowledge: Introduction to Uses of 17 Rare Earth Elements,” *KKnews*, March 27, 2017, <https://kknews.cc/finance/b28n3x6.html>.

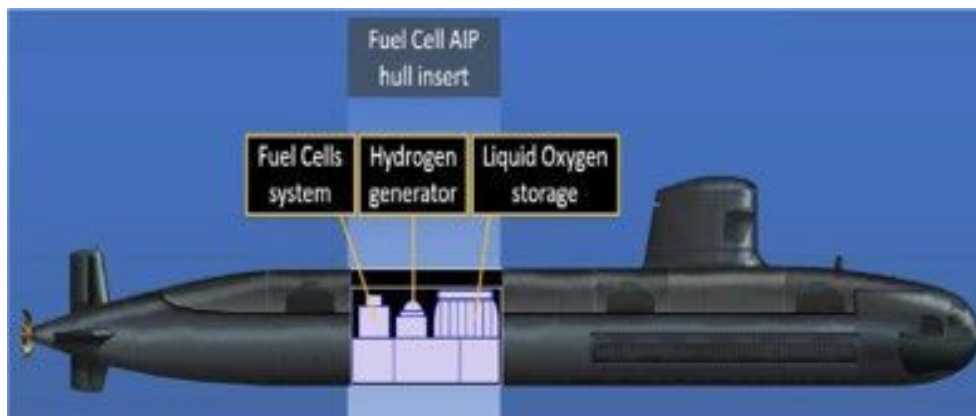
3. Trend Observation

3-1. Improved stealth performance of conventional submarines

According to the contents of the “China Military Power Report” published by the US Department of Defense in 2022, as of 2020, China possessed 6 nuclear-powered attack submarines, 6 ballistic missile submarines, and 44 conventional attack submarines powered by diesel-electric and air-independent propulsion (AIP) systems.¹⁰ The AIP systems are strongly suspected of having been installed on the Chinese Ming-class 361 submarine in 2003, which was involved

in an accident at the time of its testing. Similar equipment, as shown in Figure 1 of the Indian submarine, features an air-independent propulsion system mainly consists of three subsystems: a fuel cell system, a hydrogen generator, and a liquid oxygen storage tank. This description reveals that nearly 80% of Chinese submarines still utilize conventional diesel-electric and AIP systems. If the stealth characteristics of the materials used in the cross-sectional area are further improved, it will undoubtedly become a significant challenge for anti-submarine warfare.

Figure 1: AIP propulsion system



Source: H I Sutton, “AIP Submarines Will Increase The Lethality Of The Indian Navy,” *Forbes*, <https://www.forbes.com/sites/hisutton/2020/07/22/aip-submarines-will-increase-the-lethality-of-the-indian-navy/?sh=1d43d4b641c7>.

10. “Annual Report to Congress: 2022 Military and Security Developments Involving the People’s Republic of China,” *U.S. Office of the Secretary of Defense*, November 29, 2022, <https://www.defense.gov/News/Releases/Release/Article/3230516/2022-report-on-military-and-security-developments-involving-the-peoples-republi/>.

3-2. Anti-submarine operations will be more difficult

Submarines operating and navigating underwater possess excellent stealth and surprise capabilities; they can covertly execute combat missions, such as blockades, ambushes, and mine-laying, in the contested waters or channels. As a result, they have become a force that navies around the world strive to establish. Chinese traditional submarines, starting with the Yuan-class (039A), adopted double-hull structures, coupled with noise-dampening tiles and anti-sonar rubber coatings, while the 039B model employed a Stirling AIP system.¹¹ Now, the Chinese military adopted REEs for the new coating material for submarines and continuously enhances the submarines' stealth capabilities with advanced technologies. For Taiwan, it's imperative to strengthen underwater acoustic measurement and identification to meet the severe challenge from China.

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(The contents and views in the assessments are the personal opinions of the author, and do not represent the position of the Institute for National Defense and Security Research.)

11. Ying, Shaoji, "Comparison of the Development and Batter Capability of Conventional Submarine Forces Between China and other East Asian Countries," *Naval Academic Bimonthly*, Vol. 51, No. 6, 2017, pp. 36-50.

The Cyberspace Administration of China (CAC) Tasked with United Front Work Steps up Purification Campaign to Boost Private Sector

Yi-Suo Tzeng
Associate Research Fellow

Division of Cyber Security and Decision-Making Simulation
Topics: Digital Development, CCP Politics

1. News Highlights

On March 28, 2023, Shen Yue, director of the Center for Reporting Illegal and Undesirable Information under the Cyberspace Administration of China (hereinafter referred to as “the Office”), announced that the Office was preparing to launch a special campaign called “Qinglang” (literally “clear and bright”) to focus on problems that damage the business environment online, especially false information, infringing information, and acts that damage the reputation of entrepreneurs on the Internet to improve the online business environment and

protect the legitimate rights of enterprises on the Internet.¹

In early March, the 2023 reform package of the two legislative councils reassigned the authority and responsibility for digital industry development to the newly established National Data Bureau;² now the abrupt declaration of the Cyberspace Administration of China (CAC), a regulatory body, to improve the development of the digital economy would only look odd at first glance. In addition, when the Chinese State Council released the White Paper “China’s Online Rule of Law Construction in the New Era” on March 16, the focus of the “Qinglang”

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1. Wang Zhen, “CAC: Malicious Online Damage to the Image and Reputation of Enterprises and Entrepreneurs will be Strictly Forbidden,” *People’s Daily Online*, March 28, 2023, <http://finance.people.com.cn/n1/2023/0328/c1004-32652946.html>.
 2. “Explanation on the Institutional Reform Program of the State Council on March 7, 2023, at the First Session of the 14th National People’s Congress,” *People’s Daily Online*, March 8, 2023, <https://reurl.cc/7RKyM1>.

project, “protecting youth” and “anti-fraud,”³ was changed to “optimizing the business environment for enterprises” in less than two weeks, echoing the main theme of Xi Jinping asking local governments to promote the private economy.⁴ The meaning behind these actions is worthy of further exploration.

2. Security Implications

2-1. Private enterprises became the priority target of the CCP’s united front work after the 2023 Two Sessions

The CCP was founded on communism, with a state-owned economy as its mainstay. Although it has now been rebranded as “a socialist market economy with Chinese characteristics,” the CCP still views the private sector as distinct from the state-owned economy and a united front work object involving both cooperation and competition. Several Chinese platform groups have flourished in cross-industry development and even

listed overseas to facilitate their fundraising. As a result, they have been suppressed by the CCP in the past few years, causing fears of “the expansion of the state sector and retreat of the non-state sector. In addition, the COVID-19 pandemic and its containment measures have led to a lack of private investment confidence, which is detrimental to economic revitalization after lifting pandemic restrictions.

Since sluggish economic growth could jeopardize the stability of the CCP’s rule, the Party has launched a united front campaign targeting private enterprises since the beginning of the Two Sessions, joining forces with the private sector, the “secondary enemy,” to combat the “primary enemy,” which is the economic stagnation. On March 6, 2023, during a visit with members of the All-China Federation of Industry and Commerce participating in the first session of the 14th National Committee of the Chinese People’s Political Consultative Conference, Xi Jinping emphasized, “We

3. “The Construction of China’s Network Rule of Law in the New Era,” *People’s Daily Online*, March 17, 2023, <http://politics.people.com.cn/BIG5/n1/2023/0317/c1001-32645870.html>.

4. “Realizing the Healthy, High-quality Development of Private Economy,” *Official Chinese Government Website*, March 25, 2023, http://www.gov.cn/xinwen/2023-03/25/content_5748251.htm.

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will unswervingly encourage, support, and guide the development of the non-public sector of the economy... always treat private enterprises and entrepreneurs as our ally.”⁵ After the Two Sessions on March 13, Premier Li Qiang not only stressed the importance of boosting the economy during a press conference but also emphasized the firm commitment to developing the private sector,”...We will vigorously create a market-oriented, law-based, and internationalized business environment, treat all types of enterprises equally, and protect the property rights of enterprises and the interests of entrepreneurs by the law.”⁶ After the Two Sessions, various institutions and local governments actively echoed the theme of “optimizing the business environment.”⁷

On March 27, the CCP deliberately released the news that Alibaba Group founder Jack Ma had returned to China and appeared at Yungu School in Hangzhou after a year abroad, sending a strong signal to appease and win over private entrepreneurs.⁸

2-2. CCP regulatory authorities “step on the gas” for the united front efforts targeting private enterprises

In a press conference after the Two Sessions, Premier Li Qiang instructed that “regulators should not just apply the brakes without stepping on the gas” to boost the private economy.⁹ Following the institutional reforms of the Two Sessions, the CAC, which is specifically responsible

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5. “Xi Jinping Stressed during His Visit to the Federation of Industry and Commerce (FIC) Members Attending the CPPCC Meeting that He Was Correctly Guiding the Healthy Development of the Private Economy with High Quality. Wang Huning, Cai Qi, and Ding Xuexiang Participated in the Visit and Discussion,” *People’s Daily Online*, March 6, 2023, <http://lianghui.people.com.cn/2023/n1/2023/0306/c452482-32638164.html>.
 6. “Li Qiang: Private Economy Surely Have Great Potential,” *People’s Daily Online*, March 13, 2023, <http://lianghui.people.com.cn/2023/BIG5/n1/2023/0313/c452945-32643359.html>.
 7. “China Boosts High-quality Private Economy Development with ‘Addition and Subtraction’ in the Business Environment,” *Securities Daily*, April 1, 2023, http://epaper.zqrb.cn/html/2023-04/01/content_928742.htm?div=-1.
 8. “What Signal Did Jack Ma’s Return to China Release?” *Cnyes.com*, March 28, 2023, <https://news.cnyes.com/news/id/5128538>.
 9. “Premier Li Qiang: Don’t just Put on the Brakes without Hitting the Gas; Don’t just Set up Roadblocks without Road Signs,” *Official Chinese Government Website*, March 13, 2023, http://big5.www.gov.cn/gate/big5/www.gov.cn/xinwen/2023-03/13/content_5746486.htm.

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for digital supervision, focused the 2023 “Qinglang” campaign on improving the online business environment and safeguarding the legitimate online rights and interests of enterprises to directly echoes Premier Li Qiang’s directive to “step on the gas” for regulatory authorities to promote the development of the private economy. The CAC announced that the “Qinglang” campaign would focus on addressing the chaos in self-media, manipulation of information by online trolls, and closely monitoring the short video contents to maintain order in high-traffic areas of the internet. In particular, false and defamatory information involving entrepreneurs, copyright infringement, reputation-damaging behaviors, and the fabrication and dissemination of false information on the internet will be targeted.¹⁰

According to a report by “Hong

Kong 01,” prominent internet influencers in China with millions of followers, such as Sima Nan, have been engaged in extreme left-wing populist rhetoric advocating for a “thorough revolution.” These influencers target specific private enterprises and entrepreneurs with malicious attacks, causing fear and anxiety within the private economy. The aforementioned announcement by the CAC is akin to an official stance, no longer tolerating such discourse.¹¹ The CAC’s next potential approach is to utilize the “China Joint Internet Rumor-Debunking Platform” (Piyao.org.cn) under the Center for Reporting Illegal and Undesirable Information with its “Today’s Rumor-Debunking” column, where malicious self-media articles and short videos targeting private enterprises and entrepreneurs will be listed in its daily key rumor-debunking items and rankings.¹²

10. “CAC Takes Special Actions to Strictly Regulate Self-media Chaos,” *Hong Kong Economic Journal*, March 12, 2023, <https://reurl.cc/4QLyoR>; “CAC Will Focus on Regulating Self-media and Cracking down Online Trolls This Year,” *Hong Kong Economic Journal*, March 28, 2023, <https://reurl.cc/LNVxy9>.

11. Hang Ziya, “CAC Cracks down on Acts that Damage the Image of Enterprises and Entrepreneurs,” *Hong Kong 01*, March 28, 2023, https://www.hk01.com/article/882164?utm_source=01articlecopy&utm_medium=referral.

12. “CAC Launches ‘Today’s Rumor-Debunking’ Column,” *Xinhua News*, February 2, 2023, http://www.news.cn/2023-02/02/c_1129332278.htm.

3. Trend Observation

3-1. China's digital industry will continue to face anti-trust regulation

The CCP regulatory authorities are “stepping on the gas” to boost the private economy as a temporary united front tactic; their primary focus remains “hitting the brakes.” In addition to ongoing demands for digital platform operators to self-censor and control online content, CAC will eventually swing its antitrust sword. In 2021, industrial giants like Alibaba, Tencent, and Meituan were heavily penalized by the State Administration for Market Regulation under the pretext of antitrust. Today, even though the news of Jack Ma's return to China was released on March 27, 2023, the long-rumored Alibaba Group business split could become a reality the very next day. Alibaba CEO Daniel Zhang announced internally on March 28 that Alibaba Group would become a holding company, with Alibaba Cloud, Taobao Tmall Business, Local Life, Cainiao,

International Digital Business, and Big Entertainment becoming six independent business groups.¹³ This shows that while Jack Ma's return to China serves as a role model for Beijing to restore confidence in the private economy, Alibaba Group still cannot escape from the spell of CCP's antitrust regulation.

3-2. Regulator's united front campaign on private enterprises would cause foreign business concerns

The CCP is waving the flag of improving the business environment to boost the economy, targeting domestic private enterprises and using it as a message of confidence for foreign investors. Premier Li Qiang emphasized at the Boao Forum for Asia in Hainan on March 29, 2023, “improving the business environment and boosting market expectations and confidence... Opening up is China's fundamental national policy, and China's doors will open wider and wider. We welcome enterprises from all countries to invest and do business in China.”¹⁴ However, due to the uncertainty

13. Wu, Bowei, “Alibaba Sets up 6 Groups, Business May be Listed Separately,” *Central News Agency*, March 28, 2023, <https://www.cna.com.tw/news/acn/202303280371.aspx>.

14. “Li Qiang Meets with Asia Boao Forum Council Members,” *People's Daily Online*, March 31, 2023, <http://politics.people.com.cn/BIG5/n1/2023/0331/c1024-32654672.html>.

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of the CCP's policies, foreign businesses are very cautious about re-engaging with China and are carefully observing whether the CCP implements measures to truly open up its market to the outside world. At this moment, the CCP's regulatory authorities are making appeasing united front efforts on private businesses while simultaneously using antitrust regulation to threaten and subdue private digital enterprises and entrepreneurs. In the short term, it may be difficult to allay foreign businesses' concerns about the CCP's governance.

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