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Rush to Judgment: Inconsistencies in South Korea's Cheonan Report□□判断を急ぐ——韓国天安号報告における矛盾 •Japanese translation available

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Rush to Judgment: Inconsistencies in South Korea's Cheonan Report [A Japanese translation is available here]

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On the night of March 26, 2010, the 1,200 ton Republic of Korea (ROK) Navy corvette Cheonan was severed in the middle and sank off Baengnyeong Island in the West Sea (or Yellow Sea). Forty-six crew members died in the incident. After almost two months of investigation, the ROK government released an *interim* report that traced the cause of the Cheonan's sinking to the explosion of a North Korean (DPRK) torpedo.[1] The report, however, contains a number of inconsistencies that call into question the government's conclusion and the integrity of its investigation. In order to address these inconsistencies and to restore public confidence in the investigation, the ROK government must form a new team to restart the investigation from the beginning. We recommend that the international community continue its insistence on an objective and thorough investigation while reiterating its commitment to peace and stability on the Korean peninsula.

The Joint Civil-Military Investigation Group (JIG), made up of 22 military experts, 25 experts from 10 military-related research institutes, and three civilian experts recommended by the Parliament,[2] conducted an almost CSI-like scientific investigation[3] that involved a test explosion, a computer simulation, and such high tech analyses as EDS and XRD. In its interim report released at a press conference on May 20, it revealed three main findings: (1) the Cheonan's sinking was caused by an explosion outside the ship; (2) the explosion was that of a torpedo; and (3) the torpedo was manufactured by North Korea. The JIG drew, on the basis of these findings, the logical conclusion that North Korea was responsible for the sinking of the Cheonan. We agree that this indeed is the logical conclusion one would make if all three findings were correct.

After a careful analysis of the JIG's report and evidence and our own physical testing, however, we find that the JIG has failed (1) to substantiate its claim that there was an outside explosion; (2) to establish the causal linkage between the Cheonan's sinking and the torpedo; and (3) to demonstrate that the torpedo was manufactured by the DPRK. The JIG presented its three "findings" without credible evidence, and its findings are self-contradictory and inconsistent with facts. All three are riddled with such serious flaws as to render the JIG's conclusion unsustainable. Furthermore, there is a very high chance that its EDS or x-ray data may have been fabricated. Our results show that the "critical evidence" presented by the JIG does not support its

conclusion that the Cheonan's sinking was caused by the alleged DPRK's torpedo. On the contrary, its contradictory data raises the suspicion that it fabricated the data.

First, the JIG failed to produce conclusive, or at least convincing beyond reasonable doubt, evidence of an outside explosion. While the JIG argues in its report that the pattern of the ship's deformation and severance is consistent with the damage caused by a bubble effect from an outside explosion, its claim is not supported by the evidence. A JIG simulation showing how a bubble *might* be formed by an underwater explosion, and how it *might* sever the Cheonan, was not completed by the time the JIG released its report, as it acknowledged at the Parliament's Special Committee on the Cheonan on May 24.[4] The simulation that was shown at the conference only shows a bubble being formed and hitting the bottom of the ship, deforming the ship and making a small rupture in the hull.[5] Nowhere does this simulation show the Choenan being completely severed in the middle by the bubble, as stated in the JIG report. *Dong-a Science*, a South Korean science publication of the conservative Dong-A media conglomerate, released more information about the simulation, presumably courtesy of data supplied or leaked by the JIG, the day after Suh raised questions about the effect of the bubble.[6] Astonishingly, the updated simulation still failed to show how the bubble might have severed the Cheonan. The leaked simulation shows that after the bubble hit the ship and made a small rupture, it began to shrink and show signs of breaking up. As of the writing of this paper, more than 30 days after the JIG released its investigative report on May 20, the ROK defense ministry, speaking on behalf of the JIG investigation, admits that its it has yet to produce a bubble simulation consistent with the information presented in the JIG report. If that is the case, on what grounds did the JIG argue that the Cheonan was damaged and severed by the bubble effect? We asked that question in public but received no reply.[7]

Not only did the JIG's press conference simulation fail to show that the bubble effect *could* have cut the Cheonan, that simulation is not consistent with the pattern of the ship's damage. If the bottom of the ship was hit by a bubble, it should show a spherical concave deformation resembling the shape of a bubble, as the JIG's own simulation suggests (see the right side of Figure 1), but it does not. The bottom of the front part of the ship is pushed up in an angular shape, as the yellow line shows in the left side of Figure 1, more consistent with a collision with a hard object. The tear line in the JIG simulation has a circular shape because the hull shows a tear in the area that was hit by the spherical bubble. Equally important, if a bubble jet effect was produced by an outside explosion of 250kg of explosives, as the JIG argues, that explosion should have produced an immediate pre-bubble shock wave whose strength would have been at least 5000 psi (pounds per square inch) when it hit the bottom of the Cheonan.[8] The bottom and ruptured surface of the ship betray no sign of such a large shock (compare Figure 1 with Figure 2 that shows the damage done by 5 psi on a house); the internal instruments and parts remain intact in their original place; and none of the crew members suffered the kind of injuries expected of such a shock (Figure 3). Given that an underwater explosion produces both a bubble effect and a shock wave and the latter is usually about 6 to 10 times as destructive as the former, the ship's and the crew's condition is not consistent with the damage expected of an outside explosion.[9]

Even if the JIG could produce a simulation that shows the bubble effect severing the Cheonan, it is no proof that there was indeed an explosion that produced the bubble effect. Proof depends on a pattern of ship destruction that is consistent with a bubble effect simulation. But at this point, the JIG's May 20 press conference simulation did not show the

ship's severance and a bubble effect simulation leading to severance has not yet been completed by the ROK defense ministry's own admission. Moreover, the May 20 simulation is not consistent with the ship's deformation. The JIG's so-called first finding, therefore, is a mere allegation that is groundless and contradicted by the JIG's own evidence and at least one analysis of underwater explosions in the military literature.

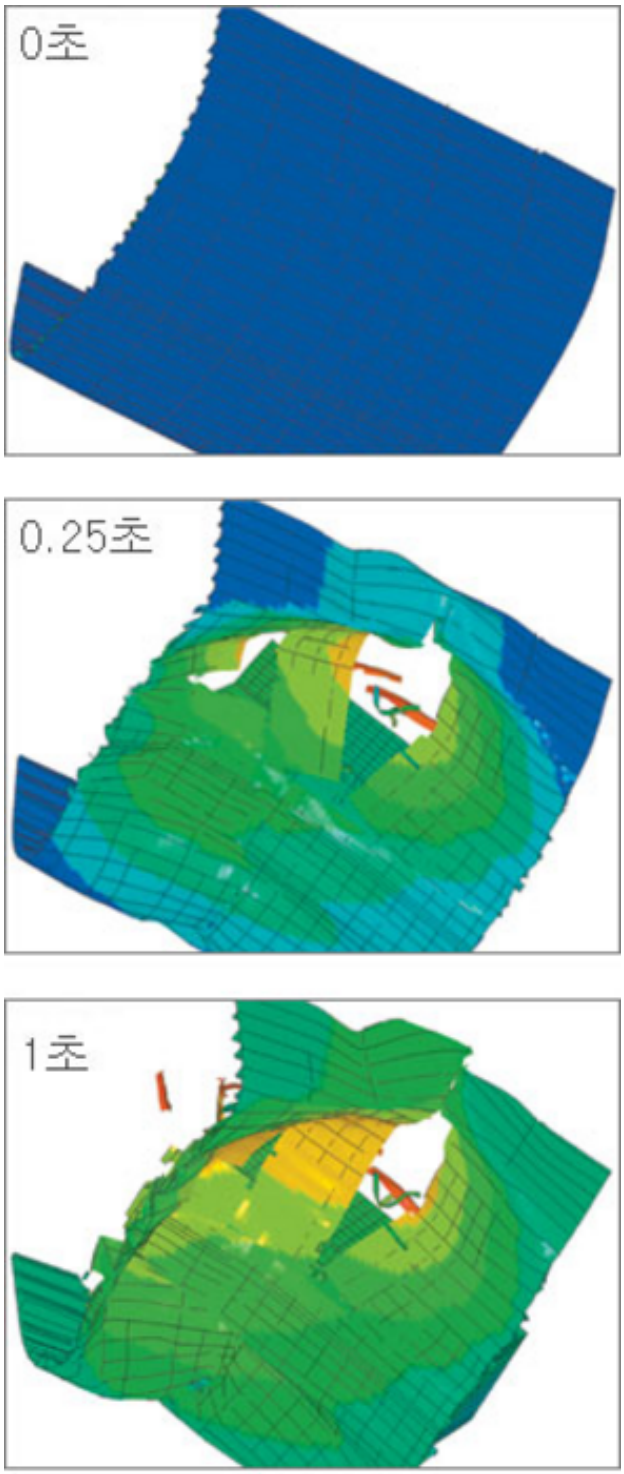

Figure 1. Cheonan's Damaged Bow and JIG's simulated damage

Figure 2. Damage done by 5 psi on a house

Figure 3. The Diesel Engine Room and Gas Turbine

Second, even if the JIG succeeded in demonstrating that an outside explosion occurred – and it did not – it still needs to show that the explosion was that of the torpedo recovered by the JIG. But its claim that the "recovered" torpedo exploded outside the Cheonan has no scientific basis. It has presented two pieces of evidence to support its claim: that white compounds – "adsorbed materials" in the JIG's report (we analyzed the Korean-language JIG report) – found on the torpedo match those found on the surfaces of the Cheonan ship; and that the compounds resulted from an explosion. We concur with the JIG on the first, but believe that the second has no basis.[10] The electron-dispersive spectroscopy (EDS) and x-ray diffraction (XRD) analyses, done by the JIG, unambiguously prove that the white compounds found on the ship (AM-1 [AM= adsorbed materials[11]]) and the torpedo (AM-2) have the identical atomic composition and chemical compounds, supporting the first piece of the evidence. But the intensity ratio of the oxygen peak and the aluminum peak in their EDS data of the AM-1 and AM-2 is very different from that of the alumina, Al_2O_3, that the JIG argues is formed during the explosion. This means that the AM-1 and AM-2 samples have nothing to do with any explosion, but are most likely aluminum that has rusted after exposure to moisture or water for a long time.[12] An independent scientist, Dr. Yang Panseok, a member of the University of Manitoba's department of geological sciences, has found that the EDS intensity ratio of hydrogen and aluminum in the compounds is not even close to that of the Al2O3 that the JIG claims constitutes the compounds. Rather, it matches that of an aluminum hydroxide, $Al(OH)_3$.[13] This alone clearly tells us that the AM-1 and AM-2 are not associated with any explosion. Furthermore, the x-ray diffraction pattern of the AM-3 third sample that was extracted from the JIG's test explosion is completely different from the x-ray patterns of the AM-1 and AM-2. The main difference is that in AM-3 sharp peaks are present indicating (1) only a fraction of the Al (aluminum) oxidized during the explosion, and (2) the un-oxidized Al remains in its crystalline form, while in AM-1 and AM-2 no signal related to any Al-related compounds was observed.[14] The JIG claims that

the compounds have different crystal structures because the real torpedo explosion produced a higher temperature and experienced a more rapid cooling by the sea water than the JIG's test explosion, and as a result, almost 100% of the Al was oxidized, and almost 100% oxidized alumina became amorphous. However, there have been several scientific experiments that approximate a real explosion, and they report that the resulting Al-related compounds are both crystalline alumina, called alpha-Al_2O_3, and amorphous alumina, called gamma-Al_2O_3.[15] One of us, Lee, has performed a laboratory test in which an aluminum sample was heated above its melting temperature and was rapidly cooled by water, mimicking the explosion conditions. When the resulting materials were examined using EDS and x-ray, it turned out that only a fraction of the aluminum was oxidized, and the resulting compound contained un-oxidized Al and alpha-Al_2O_3, both crystalline. This is consistent with previous scientific studies, and it indicates that experimental heating and cooling of Al resembles a real explosion at least qualitatively, if not quantitatively. In fact, the JIG x-ray data of the AM-3 sample (the JIG's test experiment data) shows strong crystalline Al signals and weak crystalline □-Al2O3, consistent with the Lee experimental results. However, when the media reported our experimental results and the inconsistencies between the AM-3 and the other two samples, the ROK ministry of defense responded that the crystalline Al signal found in the AM-3 sample was due to an experimental mistake, which we believe is a plain lie.[16] To summarize, our scientific analysis and experiment lead us to conclude that (1) JIG's AM-1 and AM-2 samples did not result from an explosion and (2) some of JIG's data, most likely the AM-3 EDS data, may have been fabricated.[17] Thus, the "critical evidence" presented by the JIG to link the Cheoan sinking to the alleged explosion of the torpedo is scientifically groundless and perhaps fabricated.

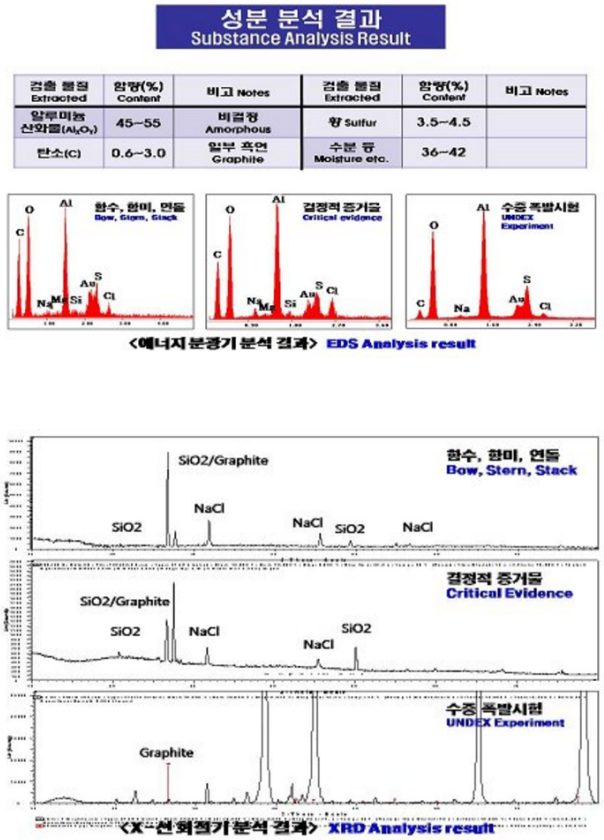

Figure 4. JIG's EDS and XRD

Third, although the JIG presented the torpedo parts recovered from the area of presumed explosion as "critical evidence" that tied the explosion to North Korea, the "critical evidence" has a serious inconsistency that casts doubt on the integrity of the evidence. The outer surface of the torpedo propulsion unit that was found was greatly corroded, presumably because the coat of paint that would have protected the metal had been burnt off during the explosion. The paint burn-off and resulting metal corrosion are consistent with a high heat explosion commonly found in bombs and torpedoes. And yet the blue ink marking of Hangul – "1bŏn" in Korean – remains intact despite the fact that ink has a lower boiling point, typically around 150 degrees in Celsius, than paint does – typically 350 degrees Celsius – and thus the ink marking should have burnt away just like the outer paint. Our simple

estimates suggest that the torpedo would have been subjected to heat of at least 350 degrees Celsius and quite likely over 1000 degrees, high enough to burn the paint and thus the ink as well. This inconsistency – the high heat tolerant paint was burnt but the low heat tolerant ink was not – cannot be explained and casts serious doubt on the integrity of the torpedo as "critical evidence."[18] Furthermore, both North and South Koreans can write the Korean letter "1bŏn", and thus we doubt that a regular court of law would consider the mark evidence of exclusive North Korean writing.[19]

Figure 5. The Torpedo with Korean marking

In conclusion, the JIG had the burden of demonstrating beyond reasonable doubt all three of its findings in order to substantiate its conclusion that the DPRK's torpedo destroyed and sank the Cheonan, but each of the three findings contain serious inconsistencies. Given that all three key claims have serious flaws, the JIG conclusion based on these claims is at least as seriously marred. While we emphatically note that our findings do not prove that North Korean did not do it, we conclude that the JIG has failed to prove that it did. The seriousness of the inconsistencies in fact casts doubt not only on the validity of the JIG conclusions but also on the integrity of its investigation. We suspect that at least some of the EDS data was fabricated, and recommend that an impartial board be formed to verify the integrity of the JIG data.

Given the seriousness of the inconsistencies, we recommend that the ROK government reopen the investigation and form a new, and more objective, team of investigators.[20] We call on the Korean Parliament to open a separate investigation into the JIG investigation itself in order to critically assess the integrity of the investigation, tests, and data. In the United States the Obama administration should support and assist an objective and thorough investigation while making clear U.S. commitment to helping maintain peace and stability in the Korean peninsula. Given the problematic nature of the JIG conclusions, the UN Security Council should urge the ROK to produce a more convincing and objective report before the council starts its deliberations. An investigation that is as thorough, objective, and scientific as humanly possible is needed to get to the bottom of the Cheonan incident to discover the cause and perpetrator. After all, forty six lives have been lost, and peace and security of Korea and Northeast Asia is at stake. The dead sailors deserve such a report. So does the international community.

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For the membership of the Joint Investigation Group, click here.

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Notes

[1] The May 20th report released by the ROK is actually an interim report. It plans to issue the final report by the end of July, 2010. Not only did the ROK government rush to judgement on the cause of the Cheonan incident, as we argue in this article, but it has also rushed to punitive measures against the DPRK, including urging the United Nations Security Council to act on the basis of the interim report.

[2] One of the 3 civilian experts, recommended by the opposition Democratic Party, was expelled from the JIG before it released its report. The person expelled was then charged by the South Korean Navy with "defaming" it for propagating the "false allegation" that the Cheonan had been grounded. Kim Kwikŭn, "Haegun, sinsangch'ŏlwiwon 'myŏngyehueson' hyŏmŭi koso [Navy Charges Shin Sang-Chul of 'Defaming' It,"] Yonhap News, May 19, 2010.

[3] CSI or Crime Scene Investigation is a popular U.S. TV series that depicts police use of advanced forensic and scientific techniques to investigate and solve crimes.

[4] Yun Dŏkyong, co-chairman of the JIG, admitted at the hearing of the Parliament's Special Committee on the Cheonan on May 24 that "we are continuing our simulation and the final result of the simulation will come out in July," conceding that "the simulation is not yet completed to show the water column [that is allegedly produced as a result of the bubble effect], but it will be all shown when the simulation is completed." Pak Jŏngi, another co-chairman, added that "the Korea Institute of Machinery and Materials [that is in charge of the simulation] said it would complete the simulation by July 15th." Kim Namgwon and Kim Pŏmhyŏn, "Kimgukpang, 'Puk, simnijŏn konggyŏkhamyŏn chŭkkak taeŭng [Defense Minister Kim, 'Will Immediately Respond if North Attacks [Our] Psychological Warfare'],"
Yonhap News, May 24, 2010. The latter quote is from "Ch'ŏanhamt'ŭkwi, 'mulgidung chonjaeyŏbu' nonnan [Cheonan Special Committee, Controversy over 'Presence of Water Column'], Yonhap News, May 24, 2010.

[5] The JIG's simulation results are available here. Although the ROK defense ministry (MND) has updated the simulation, as of July 2, 2010 it still fails to show how the Cheonan was severed.

[6] Suh Jae-Jung, "Bŏbŭlhyogwanŭn ŏbssŏtta [There was no bubble effect]," Pressian, May 27, 2010. Chŏn Tonghyŏk, "P'okbalhu 1ch'okkaji ... ch'ŏnanham paemit irŏtke jjigŭrŏjyŏtda [Up to a second after explosion ... The Chonan's bottom deformed this way]," Dong-a saiŏnsŭ [Dong-A Science], May 28, 2010.

[7] Suh, op.cit.

[8] Suh's calculation on the basis of the formula in the Australian report, Reid, Warren D. "The

Response of Surface Ships to Underwater Explosions." Melbourne, Victoria, Australia: Defence Science and Technology Organisation, Department of Defence, 1996.

[9] Ibid., page 1. The Ministry of National Defense initially stated that 70% of a torpedo's explosive energy will be a shock wave effect. After Suh's article asked why the Cheonan betrays no signs of shock wave damage, the MND decreased the ratio to 54% and 46%. The ratio varies depending on the kind of explosive and the mix of other ingredients such as aluminum powder. For the MND's initial position, see Kim Byŏngnyun, "ŏroi kiroi, sujung p'okbalŭi wiryŏk [Torpedo and Sea Mine, the Power of Underwater Explosion]," Ministry of National Defense, April 28, 2010. For its newer numbers, see Kim Byŏngnyun, "Ŏroi sujungp'okbal ch'ungbyŏkp'a bŏbŭlhyogwaro sŏnch'e p'agoe [Torpedo's Underwater Explosion Destroys Ship with Shock Wave and Bubble Effect]," Ministry of National Defense, May 22, 2010.

[10] S.-H. Lee, "Comments on the Section "Adsorbed Material Analysis" of the CheonAn Report made by the South Korean Civil and Military Joint Investigation Group (CIV-MIL JIG)," ArXiv, June 6, 2010 here.

[11] "Adsorbed materials" does not appear in the English version of the ROK's Cheonan investigative report but does appear as an English insertion in the Korean version. AM-1, AM-2 and AM-3 are designations created by Seunghun Lee in a scientific paper authored by him that discusses the JIG's analysis of the adsorbed materials.

[12] Kang Yanggu, "Ch'ŏanham deit'ŏ ch'imyŏngjŏk oryu… aluminyumŭn kŏjitmal anhae [The Cheonan data has fatal flaws… aluminum does not lie]," Pressian, June 24, 2010.

[13] Yang suspects, on a careful analysis of the JIG's EDS data, that the AM-1 and AM-2 are not aluminum oxides but more likely aluminum hydroxide, Al(OH)3, found in nature commonly as gibbsite. Kang Yanggu and Hwang Chunho, "Isanghan naraŭi ch'ŏnanham … 'aluminium sanhwamulŭn ŏbssŏtta [The Cheonan in Wonderland … There was no aluminum oxide]," Pressian, June 30, 2010 and Hankyere, June 30, 2010.

[14] Lee, June 6, 2010, *op. cit.*

[15] S.-H. Lee and P. Yang, "Was the "Critical Evidence" presented in the South Korean Official Cheonan Report Fabricated?" June 28, 2010.

[16] S.-H. Lee, "Ch'ŏnanham habjodanŭi 'gyŏljŏngjŏk chŭnggŏ'nŭn chojaktoetta [The JIG's 'critical evidence' is fabricated]," Pressian, June 16, 2010. For the Ministry of National Defense's response, see "Mo int'ŏnet maech'eesŏ pododoen 'isŭnghŏn kyosu chujang(1)'e daehan dapbyŏnimnida [Response to 'Professor Lee Senghun's allegation (1) reported in an internet media]," Ministry of National Defense, June 21, 2010.

[17] Lee and Yang, *op. cit.*

[18] The JIG argues that when the torpedo exploded, it produced heat higher than 3000 degrees Celsius and that aluminum powder in the explosive material melted and transformed into amorphous aluminum oxides, which bonded with the propeller of the torpedo. Since aluminum oxides in powder form cannot bond with another metal, it must be in liquid state. Given that aluminum's melting temperature is 660 degrees and aluminum oxide's melting point is 2000 degrees Celsius, the rear part of the torpedo must have been subjected to heat of at least somewhere between 660 and 2000 degrees Celsius, if the JIG claim is right. Whether 660, 2000 or 3000 degrees Celsius, it cannot be scientifically explained that none of this heat affected the ink marking.

[19] The ROK defense ministry reported on June

29 that the ink is made of "solvent blue-5." Recognizing that it is a common ingredient used in markers worldwide, the ministry conceded that "it might be difficult to conclude that the ink is made in North Korea." A military official added that the result of the ink analysis will not be included in the final report on the Cheonan incident due to be completed by the end of July. "'1bŏn'ingkŭsŏ solbentbŭlu5 sŏngbun gŏmch'ul [Solvent Blue-5 Detected from '1bŏn' Ink]," Yonhap News, June 29, 2010.

[20] Despite its name – the Joint Civil-Military Investigation Group – the absolute majority of its members, 65 out of 74, work for the Ministry of National Defense or MND-related think tanks and institutes. One of its two heads, Pak Chŏng-I, was a three star general at the time of the investigation, and was subsequently promoted to a four star status after the release of the report.